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ENCEPHALOGRAPHY: ROENTGENOLOGICAL AND CLINICAL CONSIDERATIONS FOR ITS USE*

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THE presence of air within the ventricles of the brain was demonstrated roentgenographically fifteen years ago by Luckett (1913) in a case of fracture of the skull. A few months later Stewart (1913) reported the same case, and Skinner (1916), a case of intracranial aerocele. Potter (1919) added another case to this striking appearance of air within the fluid spaces of the brain as shown by roentgenographic studies.

The possibility of demonstrating the cerebral ventricles by the direct introduction of air within them, as well as by the lumbar route, after the withdrawal of fluid was recognized by Dandy (1918–1919), and applied as a diagnostic procedure in cases of internal hydrocephalus and certain tumors. Baetjer (1918) at that time developed the pioneer roentgenographic technique for this procedure. Bingel (1921–1922) pointed out the value of air injections by the lumbar route. At about the same time Martin and Uhler (1922) reported a series of cases by this method which at once indicated its value.

Since encephalography was introduced, many investigators have confirmed its value as a diagnostic procedure in establishing the character, localization and extent of cerebral lesions. Its increasing use suggests the need of a clear understanding regarding the indications, contraindications, and technique surrounding this means of roentgenographic study.

The term encephalography has come to denote the method of replacement of cerebrospinal fluid with air, by means of lumbar or cisternal puncture, in contradistinction to ventriculography, which requires an operative trephine of the skull, and introduction of a cannula through the occipital lobe of the brain into the posterior horn of the lateral ventricle.

Because of its ease, and the absence of any important structures which might be injured by the needle, the lumbar route has found the widest and most popular use, though cisternal injections, as well as ventricular replacement must be resorted to where obstruction to the other method is present.

The complete withdrawal of spinal fluid from within the subarachnoid space and its replacement by air, makes possible the recording of the cerebrospinal fluid pathways and spaces upon the roentgenogram, the significance of which is a matter of interpretation based upon the known facts governing cerebrospinal fluid circulation, neuroanatomy, and structural relations.

The interpretation as to obliteration, distortion, dilatation, displacement or compensation in these fluid pathways needs

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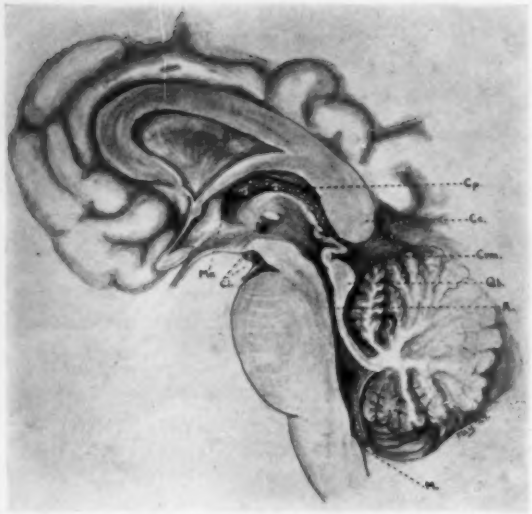

FIG. 1. Median section through the brain stem showing the third and fourth ventricles, the opening between the lateral and third ventricle by means of the foramen of Monro (Mr) and the aqueduct of Sylvius (A). Note that the choroid plexus (Cp) and the quadrigeminal bodies (Vb) separate the third ventricle from the cisterna venae magnae cerebri (Cvm). Fluid escaping from the fourth ventricle (IV) through the foramen of Magendie (M) must pass up around the pons to the cisterna interpeduncularis (Ci) and then around the surface of the cerebral peduncles to reach the cisterna venae magnae cerebri. There is no direct pathway between the third ventricle (III) and the cisterna venae magnae cerebri. The corpus callosum (Cc) forms the roof of the lateral ventricles.

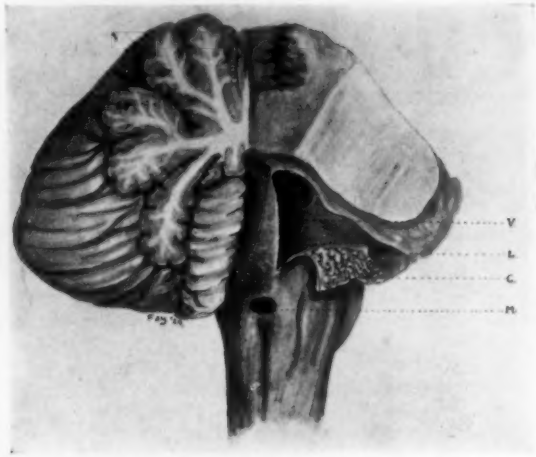

FIG. 2. Posterior aspect of the fourth ventricle (V) showing the lateral recess (L) entering the foramen of Luschka. The roof of the fourth ventricle has been opened, disclosing the choroid plexus (C). The foramen of Magendie (M) is shown posteriorly. Spinal fluid escapes from the fourth ventricle through the foramina of Luschka and Magendie.

the close co-operation between the roentgenologist and one familiar with neuroanatomy, as well as clinical neurology.

SCOPE OF THE PRESENTATION

Encephalography has proved to be of great diagnostic value. Its relative safety has justified its increasing use. The indications, contraindications and dangers will be taken up in detail. Many modifications in the technique of the procedure have been developed in the past few years, both as to introduction of air and the roentgen examination. The method described below has been found by us to insure the greatest degree of safety, ease of accomplishment and freedom from errors in technique which may lead to incorrect interpretations if structural relations are not maintained, or proper fluid drainage instituted.

THE CEREBROSPINAL FLUID PATHWAYS

Under normal conditions, cerebrospinal fluid, which is elaborated for the most part within the lateral ventricles, moves into the third ventricle, through the foramen of Monro (Fig. 1) and passes posteriorly to the small opening of the aqueduct of Sylvius. This small canal leads through the dorsal structures of the pons to empty into the diamond shaped fourth ventricle. Figure 2 will indicate the shape and structural relationships of this ventricle. The fluid having reached this space it has then three possible means of escape: (1) posteriorly in the midline directly into the cisterna magna through the foramen of Magendie (apertura medialis ventriculi quarti), or (2) by passing laterally and anteriorly around the medulla to reach the anterolateral surface, through the so-called foramina of Luschka (recessus lateralis fossae rhomboidae). As these spaces are bilateral, two possible avenues of escape are presented in the region of the vagus roots directly into the cisterna pontis (approximately the cerebellopontile angle).

Here for the first time the fluid has reached the true subarachnoid space, filling the spinal canal, the cisterna magna, cisterna pontis, and then passing upward and forward to reach the cisterna chiasmatis. There should be noted at this point a structure of much importance, the *tentorium*, dividing the anterior and middle

Fig. 3. Outline of the normal cerebrospinal fluid circulation, arising in the lateral ventricles, passing through the foramen of Monro to the third ventricle; thence to the aqueduct and fourth ventricle, where the fluid becomes subarachnoid after passing through the foramina of Magendie and Luschka. Cisterna magna and pontis are the direct recipients of this fluid. Approximately 10 per cent is absorbed throughout the spinal canal and lymphatics; 90 per cent passes to the vertex by way of the cisterna chiasmatis, thence over the cerebral cortex or up the midline to the Pacchionian bodies.

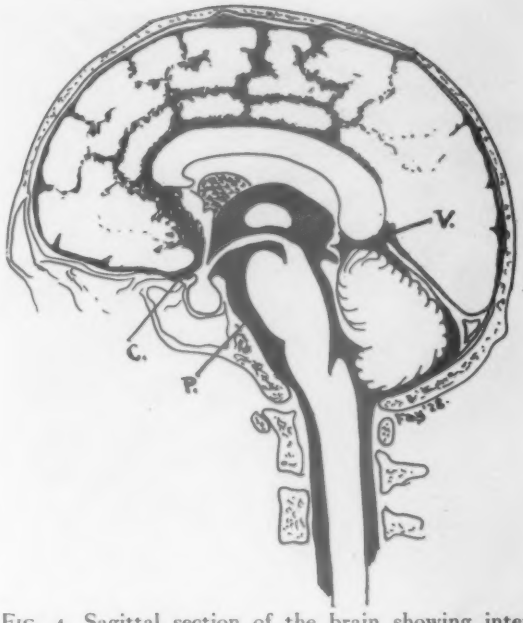

Fig. 4. Sagittal section of the brain showing interhemispheric cerebrospinal fluid pathways by way of the midline and over the corpus callosum. Note the cisterna venae magnae cerebri (V), a possible compensatory pathway in case of obstruction at the cisterna chiasmatis (C) or pontis (P).

Fig. 5. Cortical fluid pathways to the Pacchionian bodies by way of the Sylvian fissure and the sulci. Few if any normal pathways are seen in the temporo-occipital area. The relation of the ventricles as well as the position of the cisterna venæ magnae cerebri is indicated.

fossae from the posterior fossa, allowing in its incisura just room enough for the pons and the vascular structures to pass through. The fluid spaces exist on each side, anteriorly between the pons and the dorsum sellae, of this hour-glass constriction of the circulating system. This is a vulnerable point for obstruction by small lesions, as is also true in the case of the aqueduct of Sylvius.

The fluid having reached the cisterna chiasmatis finds many channels of egress to the vertex. The usual important pathways are: (1) interhemispheric midline over the corpus callosum (Figs. 3 and 4), and (2) Sylvian fissure to the Rolandic area, devious spaces over the frontal lobes (Fig. 5).

Weed (1919–1922) and his coworkers have demonstrated that approximately 90 per cent of cerebrospinal fluid absorption takes place through the subarachnoid villi, the adult forms of which are the familiar Pacchionian bodies (usually three pair), situated on each side of the midline at the vertex. It is here that we must follow the large proportion of cerebrospinal fluid

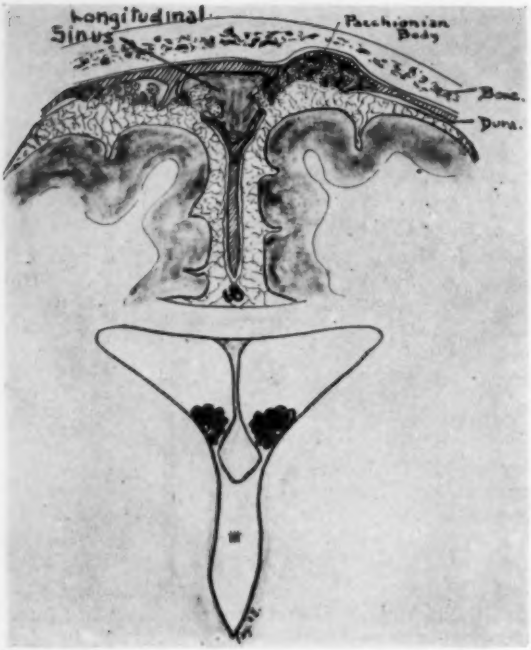

FIG. 6. The subarachnoid space over the midline, and its relation to the longitudinal sinus and falx. Pacchionian bodies included in the dural envelope are represented. Choroid plexus, lateral and third ventricle are shown below.

and the pathways which lead to these small structures.

Hence, all of the cortical fluid pathways wind directly or indirectly toward these Pacchionian bodies (Figs. 3, 4 and 5).

The subarachnoid spaces of the midline and region of the Pacchionian bodies are represented in Figure 6. The relation to the longitudinal sinus should be noted. The subarachnoid spaces over the cortical surface are, however, much more restricted, as the arachnoid is stretched from the crest of one convolution to the next, leaving fluid pathways only in the sulci or in areas of degeneration. (Space compensation theory of Dandy, 1923.)

The fine cortical air markings seen in the normal encephalogram (Figs. 8 and 9) represent air in the sulci, between the convolutions. The absence of these markings (Figs. 10, 11, 12 and 13) indicates obliteration of these normal channels by adhesions, arachnoiditis, pressure obliteration or blocking of the pathway of fluid distribution at its source (lack of fluid or obstruction to drainage), depending upon the history and clinical findings of the

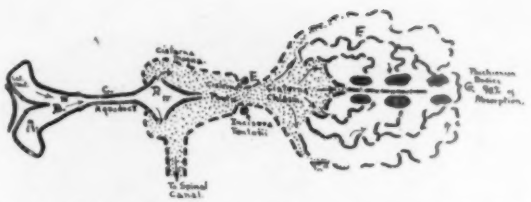

FIG. 7. Schematic representation of the cerebrospinal fluid pathways and circulation.

(A) Lateral ventricle filling defects or occlusion may be due to a mass lesion within its contents.

(B) Obstruction of the foramen of Monro may produce unilateral internal hydrocephalus, without affecting drainage from the other ventricle.

(C) Aqueduct of Sylvius, lesion in the posterior part of the third ventricle, obstructing the entrance, or adhesions, compression or filling defects of the aqueduct will produce a bilateral ventricular dilatation.

(D) Fourth ventricle lesions must be of sufficient size to occlude either the outlet of the aqueduct or all three of the foramina before dilatation of the ventricles can be expected. This type of lesion is usually cerebellar and in children is found in the roof of the fourth ventricle.

Obstruction at E will produce marked increase of pressure and subsequent moderate dilatation of the ventricles, because of the interruption of the major pathways of the spinal fluid absorption to the vertex.

(F) Large lesions are required to obliterate cortical pathways sufficiently to cause back pressure. Trauma, exudate and inflammations may divert or impair circulation.

(G) Involvement of the final absorption mechanism by disease, trauma, inflammation or hemorrhage in the Pacchionian bodies will affect the entire circulating mechanism with back pressure from the vertex, along all the open pathways, depending upon the degree of dysfunction of the Pacchionian bodies.

case. Conversely, dilatation, distortion and the development of compensatory pathways indicate blocking of the fluid at its point of absorption (Pacchionian bodies) or at some point along the normal pathways.

THE MECHANISM OF PRESSURE

In order to clearly understand the findings disclosed by the roentgen examination, and to determine the significance of the underlying pathology, the mechanism which produces these changes must be considered.

Though investigation has not definitely established the source of cerebrospinal fluid (choroid plexus, or perivascular space drainage), Fremont-Smith (1927) has shown it to be a dialysate, and the work of Dandy and Blackfan (1914), Frazier and Peet (1914–1915) and others, indicates that the major portion of it arises in the lateral ventricles, and some of the fluid

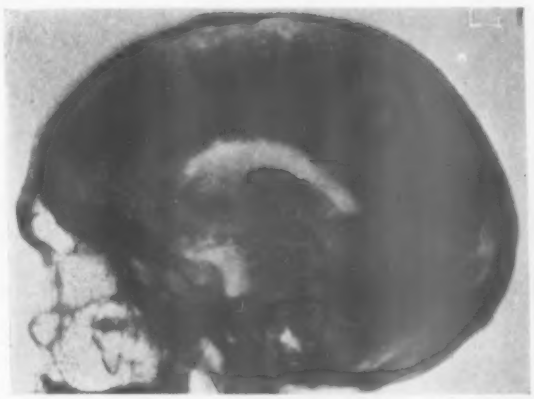

Fig. 8. Lateral view encephalographic markings in a normal patient. Note fine cortical air markings, the cisterna chiasmatis and pontis, the foramen of Monro, third ventricle, aqueduct and fourth ventricle. The absence of air over the occipitotemporal areas is normal.

Fig. 9. Anteroposterior view showing normal ventricles and cortical distribution of air. The third ventricle may be seen as well as the normal hemispheric relations in the midline.

undoubtedly from the surface of the brain and cord itself (Kubie, 1928), as well as from the choroid plexus in the region of the fourth ventricle, and its foramina.

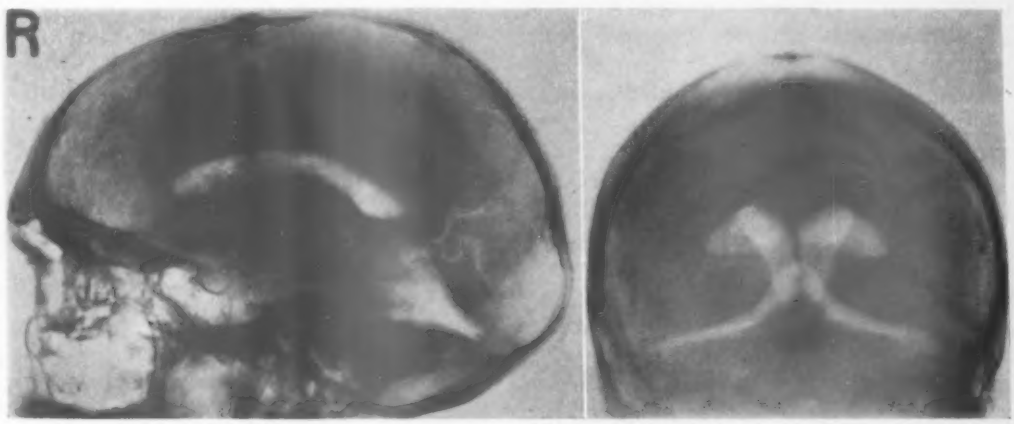

Fig. 10. Encephalogram of brain tumor suspect showing obstruction of the cisterna pontis and chiasmatis. Note failure of air to reach the frontal area and the compensatory enlargement of the cisterna venae magnae cerebri posteriorly, with channels that have developed in the occipital region, due to the diverting from the normal pathways anteriorly.

Fig. 11. Same case as Figure 10. Anteroposterior view showing greatly enlarged cisterna venae magnae cerebri, with wing-like extensions over the cerebellar hemispheres.

If then, an obstruction occurs at the foramen of Monro so as to block the outlet of one ventricle, a unilateral internal hydrocephalus will result; with the accumulation of fluid in the sealed lateral ventricle, there will be distention and dilatation. This enlargement takes place at first at the expense of the other ventricle, with displacement of the midline structures to the opposite side, until the limit of compensation is reached. Dilatation then goes on producing pressure, brain atrophy and distortion, and clinical symptoms ensue rapidly or slowly depending upon the degree of complete obstruction and the ability to compensate.

Penfield (1927) has demonstrated that brain atrophy occurs in the direction of least resistance when relief of pressure is

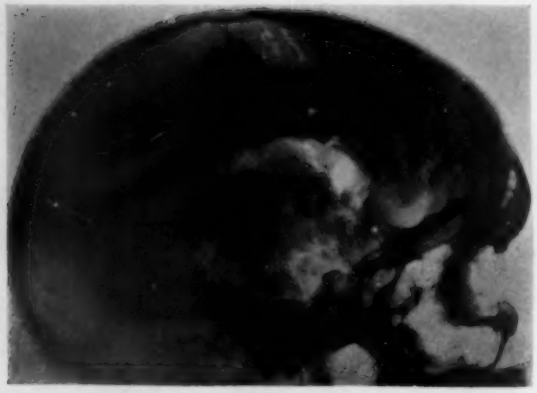

FIG. 12. Calcified meninges over the frontal area, with obliteration of fluid pathways. Note large cisterna chiasmatis and compensatory remaining pathways direct to the vertex. (From the service of Dr. C. H. Frazier.)

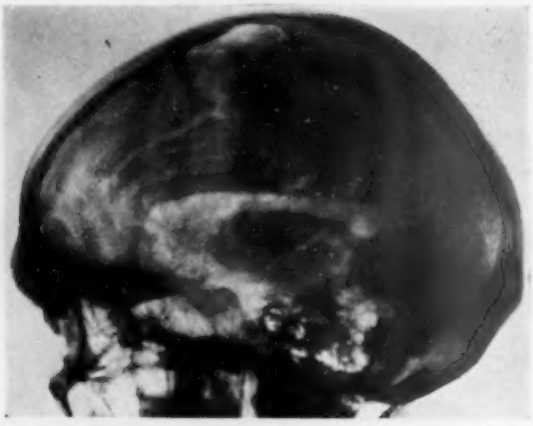

FIG. 13. Plastic arachnoiditis with compensatory enlargement of few remaining pathways to the vertex and deformity of the ventricles. Case of post-traumatic epilepsy. (From the service of Dr. C. H. Frazier.)

obtained by a decompressive opening in the skull or the cranial bones yield to the pressure from within. Weed and Hughson (1921) established the fact that the skull and spinal canal may be considered as a "closed box" after the sutures of the skull have united, thus no escape from pressure is afforded any of the structures within the entire system, for as the brain and cord structures are surrounded by fluid, they must be influenced by the laws of hydraulics within a closed space,—"pressure exerted at any point within a closed fluid system is equally exerted on all other points of that system." This is the recognized law which determines our spinal puncture pressure determinations for "intracranial pressure," which we read from the distance of the spinal fluid sac.

It is evident, therefore, that more brain atrophy occurs when the cranial bones are ununited (infancy) because of their yielding to the pressure from within, applying Penfield's principle. In the adult, grave symptoms occur long before this process can reach the extensive state that may be noted in infancy. Hence in the adult, when a large unilateral hydrocephalus, or porencephaly is found without increase in pressure or acute symptoms, it is indicative of an early process in childhood following which compensation has occurred, and the neurological signs usually indicate a long-standing deficiency or a gradually developing dysfunction.

Occlusion of the foramen of Monro may be caused by a third ventricle tumor, ependymitis, displacement of the base of the frontal lobe upward and backward by a tumor. Some have considered herniation of a redundant choroid plexus through this opening as responsible for the failure of one ventricle to fill, though this has not been demonstrated grossly.

Filling defects may occur, in which one ventricle fails to fill with air as is shown in Figure 16, without apparent explanation. It is curious that this failure has been seen in several post-traumatic cases, with other gross evidence of cerebrospinal fluid pathway distortion, but it has also been found in other conditions and as no adequate explanation can as yet be given, this failure of one ventricle to fill with air has been looked upon as a possible error in technique and its significance disregarded, unless evidence from clinical studies points to a focal lesion of that side.

A study of Figure 7 will indicate the possible results following obstruction of the normal fluid pathways. In this schematic drawing, the factors are more easily visualized. A lesion which fills the third ventricle and prevents the escape of cerebrospinal fluid into the aqueduct of Sylvius, would produce a bilateral internal hydrocephalus. Both ventricles become dilated and the third ventricle filled by a tumor would not show any traces of air; whereas, if the obstruction occurred in the aqueduct of Sylvius, the same dilata-

tion would occur in the lateral ventricles, but there would be dilatation of the third ventricle as well, making a localization possible. A small lesion situated along the course of the aqueduct would result in as great a dilatation of the lateral ventricles as a larger lesion in either the third or fourth ventricles. Obstruction to the aqueduct may also occur by pressure occlusion from a gross tumor on the outside of the brain stem (angle tumor or pineal gland tumor). Improper development, inflammations and intramedullary tumors are the usual cause of obstruction to the aqueduct.

Tumors in the region of the fourth ventricle are usually seen in children, and produce obstruction by filling the fourth ventricle. Cerebellar tumors, abscesses and angle tumors, directly or indirectly, may obstruct the fourth ventricle or its outlets by pressure or displacement, producing dilatation of the aqueduct, the third ventricle and the lateral ventricles. The result is usually a symmetrical bilateral dilatation, as all points behind this final point of outlet are equally affected.

It is important here to note that lesions involving the third ventricle, aqueduct or fourth ventricle, sufficiently to obstruct outflow of fluid, do of necessity prevent air introduced within the lumbar sac (encephalography) from reaching these structures or the lateral ventricles. Hence, encephalography in these cases is of little or no avail; but even more important is the definite risk and danger to the patient if the procedure is undertaken in the presence of increased intracranial pressure (above 20 mm. Hg) which will be considered under contraindications.

It is evident that only ventriculography (introduction of air directly into the lateral ventricle) can give the desired information. Here then in the group indicated above is the only absolute indication for ventriculography in preference to encephalography, and this factor must be kept clearly in mind. We may say as a guide to air injections as a whole, that encephalography gives the greatest information in lesions of the anterior and middle fossae (supratentorial and cortical), with less risk and by a more simple procedure; while ventriculography yields the greatest information in posterior fossa lesions (subtentorial, including posterior portion of the third ventricle, cerebellum, pons and adjacent areas). Ventriculography is more formidable because the situation of the lesions themselves entails a greater risk. The two procedures are complementary and each has its field and indications. To undertake one where the other is clearly indicated is to invite unnecessary disaster.

Lesions which are obstructive or partially so, in the cisterna magna, pontis or chiasmatis, have less effect upon the ventricular dilatations, which is of a necessity so, because of the wider range of circulation and possibility of absorption (see Fig. 7). A certain portion may be taken up by the lymphatics (Weed, 1920) or find an outlet along the nerve sheaths or through the veins (Dandy and Blackfan, 1913, and Howe, 1927). By various routes it may reach the vertex to the point of greatest absorption, therefore back-pressure on the ventricles alone is not possible to the same extent as in those lesions considered in the preceding pathways. This fact must be recognized in the consideration of the roentgenographic findings, as it may indicate the location, extent and characteristics of the pathology.

It is important to consider here what an obstruction existing at the incisura tentorii (E, Fig. 7) may produce. Air will reach the ventricles, cisterna pontis and magna, and show dilatation of these spaces, depending upon the extent and degree of the pressure, as well as the degree of obstruction. Fluid failing to reach the cisterna chiasmatis and eventually the Pacchionian bodies through the usual routes, may find another pathway. The encephalogram will show little or no air in the cisterna chiasmatis (compare Fig. 10 with Fig. 14a), and as this cistern is the distributing point for fluid over the frontoparietal region, as well as up the mid-hemispheric pathway, in all probability no air will reach the frontal area or the vertex.

However, under obstructive difficulties in the upper cisterna pontis or lower cisterna chiasmatis, the fluid may pass

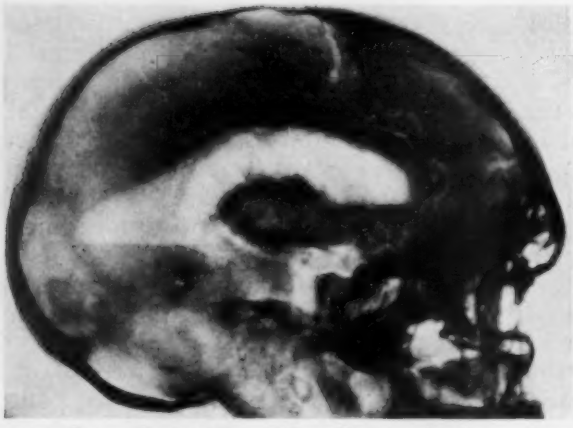

FIG. 14*a*. Case of post-traumatic epilepsy, showing plastic arachnoiditis with few remaining pathways over the frontal area. These are enlarged to compensate for the loss of the usual, many small channels to the vertex. Dilatation of the fourth ventricle and of one lateral ventricle. (From the service of Dr. C. H. Frazier.)

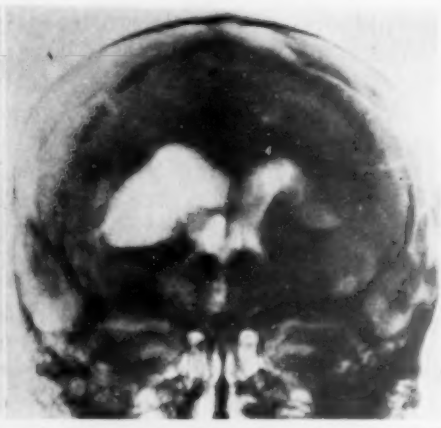

FIG. 14*b*. Anteroposterior view showing unilateral ventricular enlargement, with absence of frontal air markings.

posteriorly around the crus cerebri to reach the cisterna venae magnae cerebri (see Fig. 4) in the region of the pineal body. Here accumulation may occur causing distention of this usually small space, and the encephalogram will show a pyramidal air space just below the tentorial roof (Fig. 10) extending out towards the petrous portions of the temporal bone, in a crescentic fashion (Fig. 15). As is evident in Figure 10, fluid pathways can be shown over the occipitoparietal lobes converging toward the vertex; midline air passing to the vertex over the corpus callosum, posteriorly. This is never seen normally. In two cases its presence has been noted without evidence of obstruction in the cisterna pontis or chiasmatis, and the exact significance of the factors underlying this deviation of the cerebrospinal fluid circulation must await definite operative or pathological demonstration.

After leaving the cisterna chiasmatis, the fluid normally finds many pathways at the vertex. It is evident that as the field of circulation becomes greater and more divergent, larger or more extensive lesions are required to greatly interrupt or obstruct the pathways sufficiently to produce back-pressure and dilatation. In fact, the farther the obstruction from the ventricles, the less dilatation occurs in them from this factor alone, as would be expected.

Mass lesions sufficient to obstruct the pathways of one hemisphere, and by their volume displacement, "iron out" or obliterate the pathways of the opposite side, may be expected to give pressure signs, and the lack of air over the cortex, with careful regard to the history, will probably indicate the lesion and the process.

Here it is important to understand the mechanism of the various types of lesions.

Inflammations or exudates, as well as subarachnoid hemorrhage, fill the cortical pathways with reactive tissue and adhesions, thus in many cases (post-inflammatory, traumatic, birth hemorrhage), there will be small or large areas in which air is not seen, and it is assumed that fluid is not present, or so trapped that normal flow or drainage is impossible. Enlarged compensatory channels are then noted (Figs. 12, 13 and 14*a*) which have taken over the combined function of the many disturbed pathways. These changes have been indicated by the term "arachnoiditis," the specific nature of which must be deduced from the history or from exploration.

Weed (1920) showed that the subarachnoid space reacted violently to "particulate matter," if introduced within its meshes. Washed blood cells also produced swelling of the lining cells, and a marked reaction within the space itself. Bagley (1927) has recently shown the

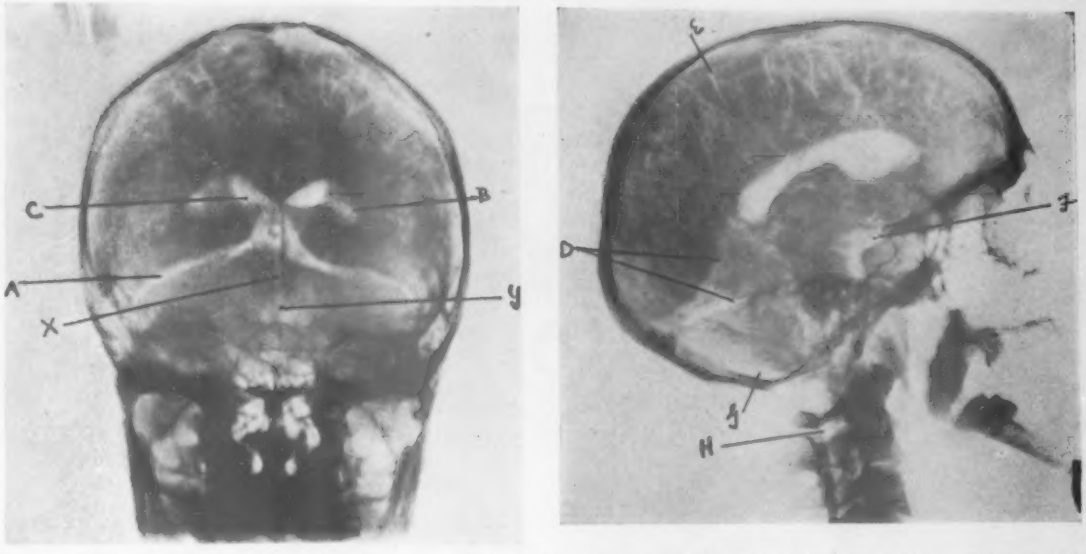

Fig. 15. Anteroposterior view shows increased air under the tentorial surface and over the cerebellar lobes extending out on each side from the cisterna venae magnae cerebri A, aqueduct X, and dilated fourth ventricle Y; C the lateral ventricle and B the posterior horn. Lateral view: D, tentorium; E, cerebral fluid pathway; F, cisterna chiasma; G, cisterna magna; H, air surrounding and clearly outlining the spinal cord. (From Pendergrass, 1928.)

obliteration of the normal spaces and the formation of adhesions and reactive tissue pathologically over the cortex following the introduction of 0.5 to 1 c.c. of blood into the cisterna magna of dogs. Sharpe (1923) has pointed out the frequency of birth hemorrhage in so-called normal infants, and suggested this as a cause of certain late cerebral manifestations.

The obliterative changes which may be noted, and the compensatory increase of the fluid spaces will vary widely, depending upon the cause, age, duration, and many factors in each case. Sufficient operative verification is at hand to establish this form of obliterative "arachnoiditis."

Tumors of the brain produce obliteration of the pathways in two distinct ways. The invasive type, such as cerebral gliomata, increase the bulk of the brain and flatten out the overlying convolutions, thus obliterating the fluid spaces between the convolutions. Many cases may cause a shift of the midline structures towards the opposite side to compensate for the bulk. Gradually the pathways of the uninvolved side will take over the diverted cerebrospinal fluid for convergence to the vertex. When these have become so impaired by the mass volume displacement that fluid can no longer find its way to the Pacchionian bodies, increase in intracranial pressure begins, and may be slow or rapid depending upon the degree of involvement, and its location in regard to the important fluid pathways. An encephalogram may therefore reveal a displacement of the ventricles to one side with some distortion, or filling defect of the ventricular outline, as well as obliteration of the overlying cortical pathways on the side of the tumor.

On the other hand, slow-growing extramedullary tumors (fibroblastoma) cause displacement and brain atrophy as they progress, and may be present for many years before they obstruct fluid pathways sufficiently to cause signs of intracranial pressure. They may reach huge proportions at times, before the final phase of pressure occurs. Cerebellopontile angle tumors may be comparatively small and produce rapid and high degrees of pressure, because a most important pathway has been blocked on one side and obliterated by pressure displacement on the other.

The above factors must serve as a guide in the interpretation of encephalograms in cases of brain tumors. The variations and exceptions are so many that detailed consideration is not possible in this presentation.

The consideration of the Pacchionian

FIG. 16. Cortical atrophy in case of an infant three months old with spastic paralysis.

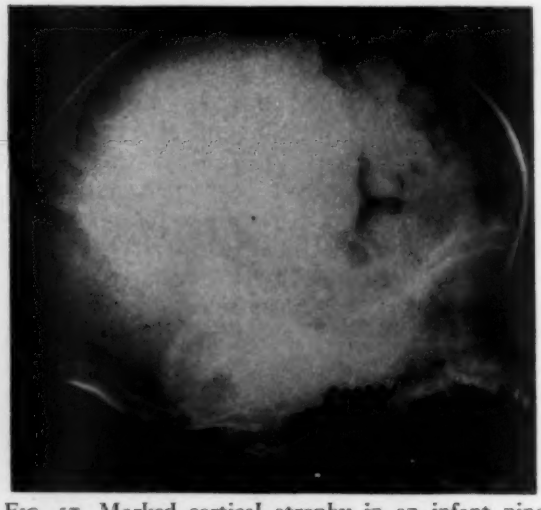

FIG. 17. Marked cortical atrophy in an infant nine months old, with convulsions and spastic diplegia. Note shrunken frontal and occipital poles.

body zone is perhaps one of the most important in encephalographic determinations regarding the significance of the cortical air shadows.

One of us (Fay, 1928) has recently pointed out the significance of disease, trauma and imperfect development of the

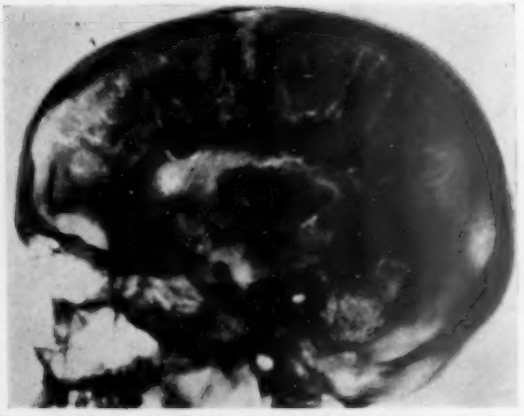

FIG. 18. Case of epilepsy showing increased cortical air markings and atrophy over the frontal pole.

Pacchionian bodies in relation to external hydrocephalus, local brain atrophy, epilepsy and supracortical edema. Based on neuropathological studies with Winkelman, it was possible to show that after impairment of the Pacchionian structure, due to inflammation, infection, toxic, eclamptic and traumatic influences, as well as subarachnoid hemorrhage, tumor or imperfect development, the absorption of spinal fluid was not sufficient to meet the demand placed upon the deficient structures. Accumulation of fluid around the final outlet in small lakes and pools, and distention of the pathways over the cortex were found, associated with atrophy of the cortical zones included in the cerebrospinal fluid areas of back-pressure, producing marked changes such as seen in Figure 16, as early as the third month of life, and again in Figure 17 at the ninth month.

These processes and others of less duration seen after many years have elapsed between the injury or inflammation, probably lead to the characteristic variations of cortical atrophy, some of which are shown in Figures 18, 19, 20 and 21.

It will be noted that in some cases (Fig. 22) there is distortion of the ventricle on the side of the gross brain atrophy. This has been ascribed to shrinkage of the brain with contractures which have pulled the ventricular wall toward the cortex. It is the reverse of the picture seen when intraventricular pressure has existed from within, as the structures are then pushed

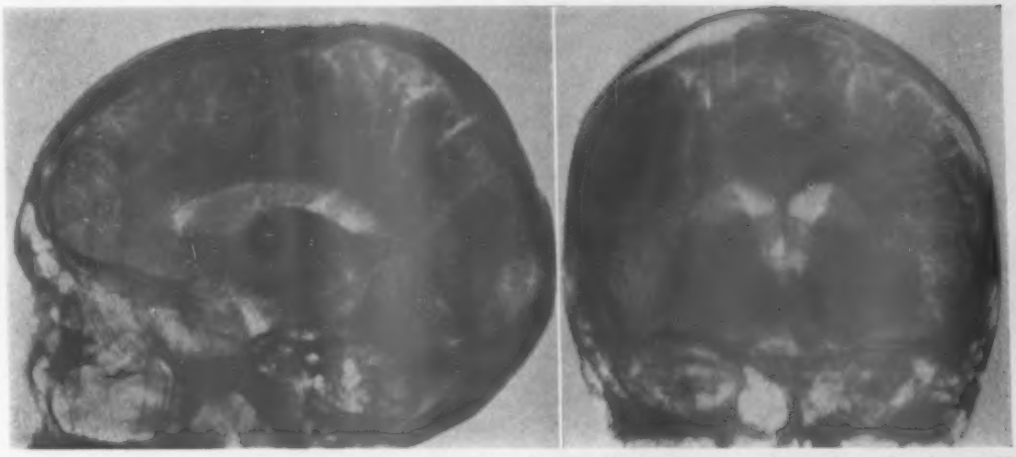

Fig. 19a. Post-traumatic epilepsy, with distinct parietal lobe atrophy. (From the service of Dr. C. H. Frazier.)

Fig. 19b. Anteroposterior view showing unilateral increase of air at the vertex.

to the opposite side of the midline and the overlying cortical fluid pathways may be obliterated instead of enlarged.

INDICATIONS

As encephalography is the replacement of spinal fluid by air introduced into the subarachnoid spaces surrounding the brain, and within its ventricles, the indications and contraindications are dependent upon the foregoing understanding of the cerebrospinal fluid which the roentgenological studies, in the presence of air, will disclose. The introduction of air into the subarachnoid space, if properly undertaken, with due regard to the indications and contraindications, is an entirely safe procedure and is associated only with rather extreme headache on the part of the patient, for some hours following the injection. Other symptoms and manifestations such as transient nausea, vomiting or profuse sweating have not been found to be serious, unless the procedure has been undertaken in the presence of a contraindication, which will be outlined below. The roentgenological studies are those of the fluid spaces which have been replaced by air, and hence the interpretation of deformities, obliterations, obstructions and enlargements, is possible in terms of the surround-

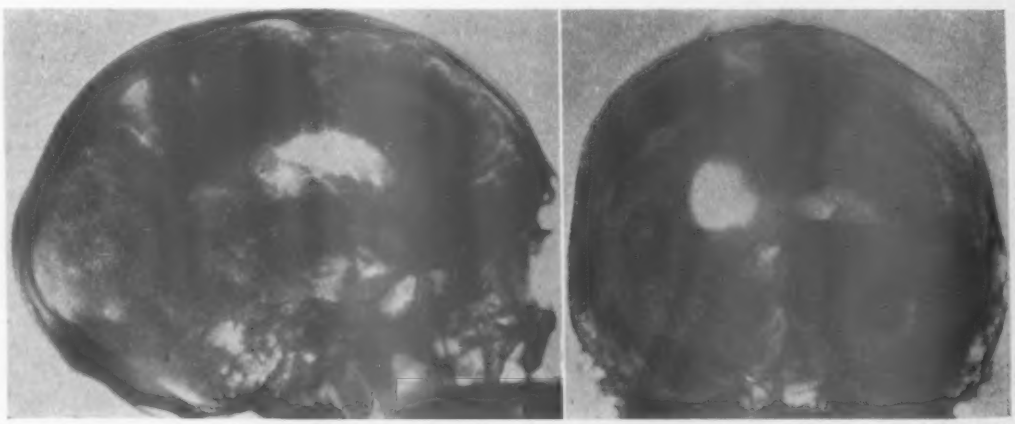

Fig. 20a. Post-traumatic epilepsy with scattered areas of cortical atrophy, distortion and dilatation of the lateral ventricles and compensatory parieto-occipital pathways. (From the service of Dr. C. H. Frazier.)

Fig. 20b. Anteroposterior view showing unilateral dilatation of the ventricle with bilateral areas of cortical atrophy.

FIG. 21a. Post-traumatic neurosis. Widespread cortical arachnoiditis with few remaining pathways, brain atrophy (internal) with irregular and dilated ventricles. (From the service of Dr. C. H. Frazier.)

FIG. 21b. Anteroposterior view showing huge dilatation of the left ventricle, with brain atrophy. Note structures are not displaced beyond the midline. (Compensated brain atrophy in contradistinction to unilateral hydrocephalus.)

ing structures themselves, which may be of definite value in pointing to, or indicating the probable pathology.

It is at once evident that the indication for encephalography would therefore be any condition of the central nervous system, particularly of the brain or its surrounding structures, which would impair, obstruct, obliterate or distort these fluid pathways, and that many lesions which do not give focal clinical evidence of their nature or exact location, may thus be determined roentgenologically by observing to what degree, and in what areas, changes in the subarachnoid fluid spaces have occurred.

The indications therefore, may be found in cases where obscure symptoms arise following trauma, inflammation and senility, or the consideration of the resultant pathology from changes underlying epilepsy, hemorrhage, brain tumors, hemiplegia, birth injuries and cerebral manifestations of uncertain origin. Many hundreds of cases of encephalography have been undertaken on patients suffering from a wide variety of neurological diseases. Much information of importance has been gained by this method, and it is now possible to correlate some of the findings with known pathology, where such diagnoses have been confirmed or established by operation or necropsy.

CONTRAINDICATIONS

With an understanding of the cerebrospinal fluid mechanism and pathways, it

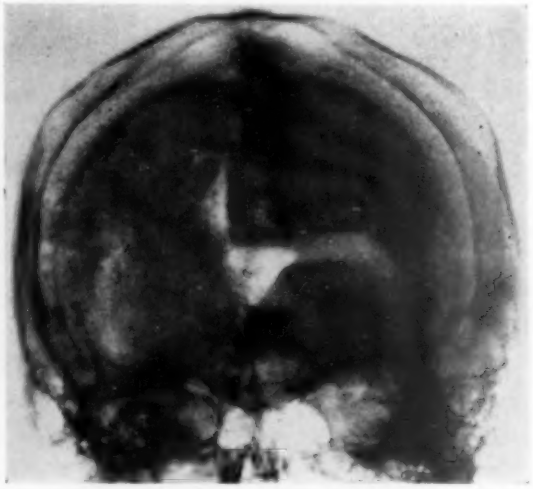

FIG. 22. Post-traumatic epilepsy with deformity of the lateral ventricle and increase in cortical air on the same side (temporal region). Note the absence of air over the cortex on the opposite side. (Probably diffuse arachnoiditis.)

is evident that any obstruction produced within the third ventricle, the aqueduct of Sylvius or the fourth ventricle, either directly by a tumor, lesion, or obliteration of these channels by a tumor, or secondarily through pressure by a mass lying

sufficiently close to distort or disturb this cerebrospinal fluid circulation, such as cerebellar tumors, angle tumors, intramedullary gliomas of the peduncle, third ventricle, floor of the fourth ventricle, or pons, will produce an internal hydrocephalus, so that the fluid elaborated within the ventricles is unable to escape or find its way to the subarachnoid spaces or areas of absorption over the vertex. This produces a definite increase in ventricular pressure, and following the laws of hydrodynamics within a closed space, surrounded by a fluid, a coincident increase in general intracranial pressure, because the structures comprising the brain between the ventricles and the outer surface, are soft and not rigid, and they therefore yield to the pressure from within until they have met with an equalizing pressure against the supporting fluid envelope, and the rigid bony walls from without.

It is evident now that if the pressure surrounding the brain be disturbed by removing the bony wall (decompression), the pressure within the ventricle will force the brain out through the opening, producing a hernia. It is likewise evident that if the surrounding fluid, which is equally resisting the pressure from within the ventricle is withdrawn by spinal puncture from the lumbar sac, hernia of the brain will occur in the direction of the release of pressure, i.e., portions of the cerebellar hemispheres forced down through the foramen magnum.

This so-called foraminal hernia or cerebellar hernia is a very real condition. Too frequently, the sudden deaths following lumbar puncture alone, where careful study has not eliminated the possibility of a lesion in the posterior fossa or involving the third ventricle or aqueduct, have been due to this foraminal or cerebellar hernia. The mechanism is similar to a cork in a bottle. The lobes of the cerebellum are forced down around the medulla, in the region of the respiratory center and its pathways to the upper cervical phrenic area. This produces a rapid or immediate respiratory failure, or one which may develop within four or eight hours after the lumbar puncture. This is the most important contraindication for any procedure or test which requires withdrawal of cerebrospinal fluid from the lumbar sac, as no matter whether encephalography is undertaken or a simple spinal puncture, the danger is identical. The fluid trapped in the ventricle under pressure expands the soft brain structures in the direction of the release of pressure, and hence in cases which present this problem, it is imperative that ventricular pressure be reduced before undertaking either lumbar puncture or encephalography. The ventricular pressure may be reduced in several ways: by ventricular drainage preferably through the occipital lobes using the method which is followed in undertaking a ventricular estimation or ventriculography, by callosal puncture or by dehydration. With the pressure within the ventricles relieved, and drainage by means of a cannula still intact, it is then possible to undertake encephalography, if this is needed, without the risk of a foraminal hernia. However, in those cases where intraventricular pressure is sufficient to indicate a ventricular tap, air may be introduced into the ventricle, giving a ventriculogram which in all probability will yield satisfactory results and permit of an interpretation of the pathology underlying the ventricular obstruction. This contraindication has led to the need for a careful neurological study and the recommendation for encephalography, after extreme care has been exercised in ruling out any obstructive lesion of the posterior fossa. The neurological studies, associated with the Bárány test, audiometer and careful determinations of the sense of hearing, special regard to the basal ganglia and evidence of involvement of the nuclei of the pons, and medulla, should indicate the presence of a posterior fossa lesion, and thus safeguard this procedure.

In our experience, there have been no fatalities or untoward effects from encephalography because of the care with which these determinations have been made. The very few fatalities reported in the literature have been associated with unlocalizable tumors, or with some disregard to the careful preparation of the case. This point cannot be too strongly

emphasized, as encephalography is of great value when properly undertaken, and where no serious contraindications are present. This has led to the arbitrary selection of a definite amount of intracranial pressure in the presence of which encephalography is safe, or contraindicated.

It is our distinct impression that with spinal pressures over 20 mm. Hg in the prone position, there is present some severe form of spinal fluid pathway obstruction, and when the pressure is 20 mm. or over, great care must be exercised in determining whether an encephalogram is justified. Lumbar puncture should always be done in a case of suspected brain tumor, with a fine No. 22 or 24 round point, Green needle, so that if pressures above 20 mm. Hg are encountered, the needle may be withdrawn without the loss of spinal fluid, or the disturbance of the pressure mechanism within the cerebrospinal fluid system, leaving no tear or hole in the dura sufficient to permit of a concealed or unrecognized leakage, and hence favor a cerebellar hernia.

The symptoms of the patient may clearly establish as to whether the lesion is situated above or below the tentorium, although the exact location of the lesion is impossible. This is arrived at by positive, as well as negative findings. If pressure is above 20 mm. Hg, the patient is then dehydrated, by limitation of fluid intake to a maximum of from 8 to 12 ounces per day, and the administration of magnesium sulphate by mouth for a day or more prior to the contemplated encephalogram. If pressure may be reduced below 20 mm. it has been found that there is little or no danger of a cerebellar hernia. Should the lesion include some of the aqueduct or the third or fourth ventricle structures, 20 mm. of pressure is not sufficient to drive the structures through the foramen magnum. It is also evident that with any obstruction of the fourth ventricle or aqueduct, and the failure of fluid to escape from the ventricles, there will be no possibility of air entering the ventricles and therefore no ventricular picture will be obtained in these cases, hence an encephalogram will not give as much information as a ventriculogram, and in this group of cases alone, in our opinion, is ventriculography, with its definitely higher mortality and its requirement for a cranial operation, indicated.

Where the obstruction occurs over the surface of the brain, such as plastic exudate, trauma, hemorrhage or disease of the Pacchionian bodies, pressure may be extremely high: 40, 50 or 60 mm. Hg has been recorded. In these cases where the pressure is far over 20 mm., the arbitrary figure for caution, the mechanism, however, is different and cerebrospinal fluid may be withdrawn without danger, and an encephalogram made sometimes with great profit. The reason for this group of cases representing a margin of safety in contradistinction to those discussed above is as follows: Obstruction occurring along the pathways around the Pacchionian bodies, or in the Pacchionian bodies themselves, presents the point of obstruction at the very outlet of the cerebrospinal fluid circuit, and the same degree of pressure may be reached as in cases where the aqueduct has been obstructed, but the pressure originates first over the cortex, and *back-pressure* involves the pathways of the cisterna chiasmatis, cisterna pontis, and cisterna magna, back up the aqueduct and finally into the ventricles. Fluid unable to escape through the Pacchionian bodies will accumulate giving rise to increased pressure. Lumbar puncture and withdrawal of this fluid is safe because the aqueduct and entrance into the ventricles is freely *patulous* and *open*, and again our principle of hydrodynamics, that pressure exerted at any point within a closed fluid system is equally distributed to all points within that system, may be applied. Spinal pressure, ventricular pressure and cortical fluid pressure are the same at all times and fall in pressure equally and simultaneously at all points during drainage.

When fluid is withdrawn from the spinal canal the fluid within the ventricles escapes readily and diminishes the pressure equally at all points simultaneously, so that there is therefore no danger of a herniation of the cerebellum, because pressure has been equally reduced from within and from without, so drainage in

these cases may be safely instituted, and encephalography performed with very little risk.

A group of cases in which danger presents itself in another form must also be considered.

Gliomata are notorious for the fact that with very slight disturbance of intracranial pressure or cerebral circulation, there may be a rupture of the diseased vessels within the tumor; hemorrhage and a rapid sponge-like increase in the volume of the tumor follows. This is frequently spontaneous in those cases which succumb without operation, and is the cause perhaps of the largest portion of mortalities following exploration of a glioma, and frequently is responsible for the sudden deaths or delayed deaths following lumbar puncture in this type. No matter what procedure is undertaken, the danger from this source is always present in gliomata and must be recognized when dealing with such a case. It is evident therefore, that lumbar puncture, encephalography, ventriculography, ventricular estimation or explorations may all be equally dangerous; nevertheless, the procedure of least trauma, rendering the clearest details of the extent and location of the lesion, is encephalography, and this risk must be assumed with the full understanding that any procedure is equally dangerous, if the patient demands a more specific means of localization.

In reviewing the reports of 1,529 cases of encephalography, there appeared 20 fatalities in this series. Fourteen of them occurred in cases of brain tumor; whether immediate or by delayed disturbance of the cerebrospinal fluid mechanism, there resulted a similar fatality.

TECHNIQUE

The patient designated for an encephalogram has in all probability recently had a lumbar puncture with a determination of pressure, as no careful neurological examination is complete without this finding, so that the operator has considered the risk in the light of pressure which may be present.

The patient is placed upon a litter preferably (Fig. 23), and lumbar puncture done in the prone position by introducing an unbreakable needle (gold or nickoloid steel) between the fourth and fifth lumbar spinous processes and interspaces. When clear, colorless fluid is encountered, the pressure reading is made to determine the exact pressure at the beginning of the procedure (Fig. 24). The second needle is then introduced at one interspace higher, between the third and fourth processes (Fig. 25). When clear, colorless fluid has been encountered in this second needle, the manometer is at once disconnected, the stylets of the needles replaced, and the patient carefully raised to the upright sitting position, care being taken to maintain the relative curvature of the back in relation to the needles, so that no change will occur in the location of the points of the needles within the spinal canal. When the patient is in the sitting position, and the head in the midline, the mercury manometer is connected to the upper needle and remains connected to this needle throughout the procedure (Fig. 26).

The normal pressure in the sitting position for adults is approximately 20 mm. Hg, a change from the prone position, where the normal is 6 or 8 mm.

If in the prone position, the pressure reading was 18 mm. Hg, after placing the patient in a sitting position the pressure may be recorded about 30 mm. Hg. This is a fairly constant ratio but in order to avoid the additional pressure in assuming the sitting position, if upon the introduction of the first needle the pressure has been found to be above normal, the spinal fluid is then withdrawn until the pressure registered is 8 mm. Hg, and then the patient is placed in the sitting position, the pressure should fall near 20 mm. Hg, the normal. The stylet of the lower needle is then removed and spinal fluid permitted to drain freely into a small graduated container, so that the exact amount of spinal fluid obtained during encephalography may be measured. The pressure is allowed to drop from the neighborhood of 20 mm. to approximately 8 or 10 mm. Hg, and when this point is registered on the manometer, air is introduced by means of a sterile 20 c.c. syringe. It has not been found necessary to take

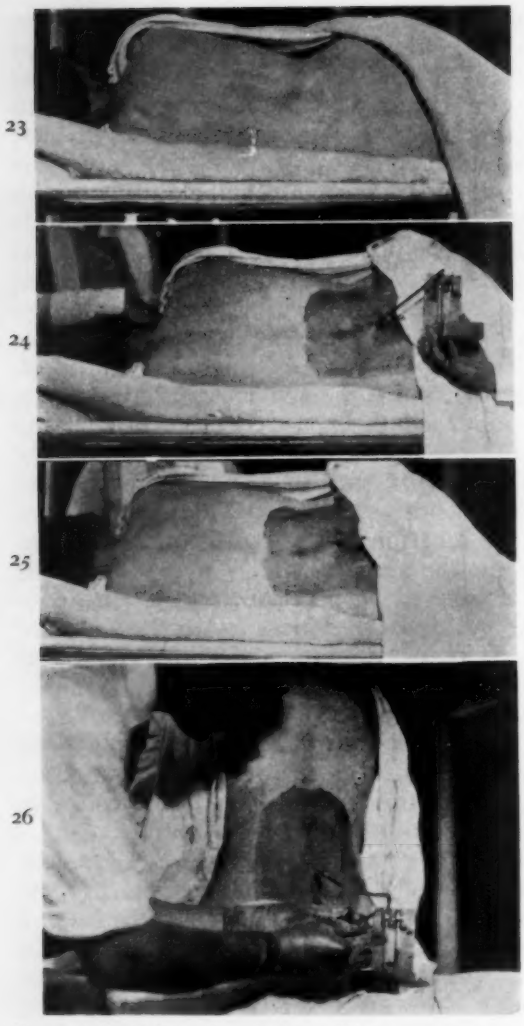

FIG. 23. Position of patient on litter, preparatory to encephalography by the lumbar route.

FIG. 24. The initial pressure reading in the prone position.

FIG. 25. The introduction of two needles into the spinal canal between the third and fourth and fourth and fifth interspaces, respectively.

FIG. 26. Patient in sitting position. After gradual spinal drainage, the fluid being permitted to drop from the lower needle, air is introduced into the lower needle by means of a 20 c.c. syringe. Note the constant pressure readings by manometer connected with the upper needle. Mercury on the right hand column should never read higher than 20 mm. Hg during introduction of air.

any other precaution in the selection of air within the room itself, other than drawing back the piston of the syringe, with a piece of sterile gauze held over the nozzle. The syringe with the 20 c.c. of air is then connected directly with the lower needle and the air gradually introduced,

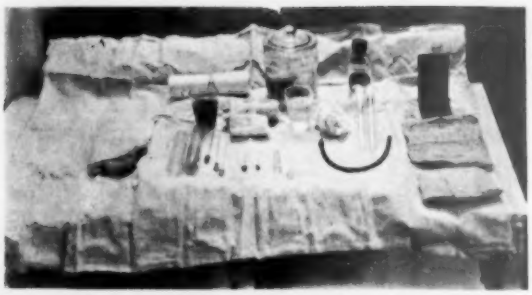

FIG. 27. Necessary equipment for encephalography by the lumbar route: (1) alcohol, sponges; (2) iodine; (3) sterile cover; (4) sterile gloves; (5) novocain 1 per cent; (6) hypodermic syringe for local anesthesia; (7) three nickoloid steel No. 18 gauge, Babcock spinal needles; (8) connection tube to manometer; (9) U-tube mercury manometer; (10) sterile 20 c.c. syringe; (11) gauze, test tubes, record charts, and incidentals.

watching the spinal manometer change, so that as the pressure rises, air is introduced up to a point where the pressure again reaches 20 mm. Hg, irrespective of the amount of air introduced, in proportion to the fluid withdrawn, as at no time should there be permitted a pressure of more than 20 mm. to exist as registered by the spinal manometer connected with the upper needle. When 20 mm. Hg has been reached, the syringe is withdrawn from the lower needle, and spinal fluid again permitted to drain until the pressure has fallen to 10 mm. or below, and again air is introduced sufficient to increase pressure to 20 mm. Hg. *Fluid should never be sucked out by the syringe.*

During this procedure the assistant or nurse gradually rotates the head, flexing it forward onto the chest and backward, as far as possible, with intermittent rotations in a circle from side to side, as close to the shoulder as can be permitted without moving the spinal axis of the patient. It is important that the head come to rest in the midline after each manipulation, and when 80 to 100 c.c. of fluid has been withdrawn, it will be perhaps noted that fluid runs slowly, and that during periods when the chin is flexed on the chest, a free drainage of fluid may result. This process is necessary in order to empty the ventricles.

A satisfactory injection of air in the adult should require the withdrawal of at least 90 to 120 c.c. of fluid, and the intro-

duction of from 80 to 100 c.c. of air. When possible, 100 c.c. or more should be the amount decided upon, otherwise the roentgen study will be unsatisfactory from the standpoint of interpretation. It will be noted that the final pressure produced after the withdrawal of 120 c.c. of fluid, and the introduction of only 108 c.c. of air is 20 mm. Hg, the top normal limit for final pressure.

For example, the manometer reading will register 20 mm. Hg pressure, although 10 or 12 more c.c. of fluid has been withdrawn than air introduced. This discrepancy between fluid and air in all probability is due to the fact that there is a compensatory amount of expansion of the air when taken from a room in which the temperature is about 80°, and placed in the spinal canal where the temperature is approximately 98°. This "pressure for pressure" method has proved to be safer because in attempting to introduce equal quantities of air for the fluid removed, acute intracranial pressure may result, and the symptoms have been those of syncope, slow pulse and some respiratory difficulty. As long as the pressure readings do not permit a rise of over 20 mm. the amount of air introduced is sufficient to compensate for the amount of fluid withdrawn, and leaves the patient in a normal equilibrium, regardless of the differences in volume between air and fluid.

It has been our custom, at the end of an air injection to permit further drainage of fluid or escape of air, so that the final pressure is around 10 mm. Hg, thus compensating for the spinal fluid elaboration which may occur during the next half hour, before the opportunity has been afforded the patient to absorb some of the air present. This addition of spinal fluid in a closed space, already filled with air, though the pressure was 20 mm. and normal at the time the procedure was terminated, may accumulate sufficiently to compress the air, and produce intracranial pressure before compensation can occur. It is therefore our experience that the best results have been obtained in those cases where, after finally reaching a point of equalized pressure, when in the judgment of the operator, sufficient air has been introduced, that just prior to withdrawing the needles, the pressure is allowed to fall to 10 mm. in the sitting position.

The two spinal needles are then withdrawn after the final spinal pressure reading, and the patient placed in a wheel chair, still in the sitting position, with the head maintained in the midline. The patient is taken to the roentgenological department where films are secured in the sitting position. It is important that the upright position be maintained throughout the entire procedure, so as to give equal distribution of air to both hemispheres and the ventricle. If the patient is permitted to recline and lie on one side, there will be a distortion effect, due to the accumulation of air at the highest point, with the readjustment of fluid and the filling of the fluid spaces at the most dependent point, and this may lead to errors in technique and interpretation, which will make the procedure of little value.

In our experience the following symptoms are usually noted in the patients. At the introduction of about 40 c.c. of air, they complain of severe frontal headache; this is an indication of air having reached the subarachnoid channels over the frontal lobe. It is the usual manifestation, and may indicate that a satisfactory injection will be obtained. Following this period, if the pressure has been carefully regulated, not to exceed 20 mm. Hg at any time, the patient will show profuse sweating. This is at first noted over the forehead and becomes generalized, and the patient may complain bitterly of headache and some faintness, but there have been no untoward symptoms following these manifestations, if pressure has not been pushed above 20 mm. Hg. The rotation of the head will at times precede vomiting after the ventricles have been drained, and this should be anticipated. The period of vomiting may occur during the injection or following it, and frequently is absent if the introduction of air has been gradual, and the movements of the head regulated to slow manipulation. Rapid changes of the position of the head are frequently associated with an attack of projectile vomiting, and it is therefore important, after the rotation procedure,

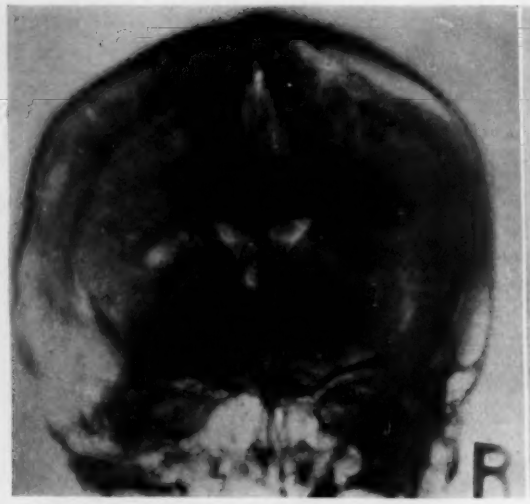

FIG. 28. Midline and right cortical atrophy in case of suspected syphilitic arachnoiditis with mental deterioration.

FIG. 29. Same case as in Figure 28, twenty-four hours after air introduction. Note sagging of the brain surface with partial collapse of the ventricles.

and during the transfer of the patient to the roentgenological department, that the head be held by some assistant in the upright position, as the patients usually desire to lie down or relax, so that the head falls backward. Slowing of the pulse may be encountered, and sixty beats per minute is not an uncommon result of this air injection.

The headache is intense, and this factor must be carefully explained to the patient before undertaking the procedure. It should not, however, deter one from undertaking a procedure which has proved to be of such diagnostic value. Rarely have we found it necessary, because of low pulse or respiratory disturbance, to remove the air after the roentgen films have been taken. This is a simple procedure if required, and is undertaken when the patient is returned to bed; a needle is introduced with the patient in the prone position, and if intracranial pressure is present, spinal fluid, or bubbles of air will emerge from the needle until the pressure has been equalized. Some operators prefer to insert the needle and place the patient in the knee-chest position, so that air rising in the spinal canal is discharged to a large extent through the spinal needle, but this means of relief has been found necessary in only 3 cases in our series.

In order to control the headache, which is the only disturbing element, chloral hydrate, gr. 15, has been given to the adult patient about one hour before undertaking encephalography, and may

FIG. 30. Same case as Figures 28 and 29, forty-eight hours after introduction of air into the lumbar sac. Residual air in the ventricles and over the cortex.

be repeated in four hours if necessary. The patient should be given codeine, if indicated. The headache usually persists in a severe form for six to eight hours, when following this, it gradually abates, and may be present to some slight degree during the ensuing twenty-four to thirty-six hours.

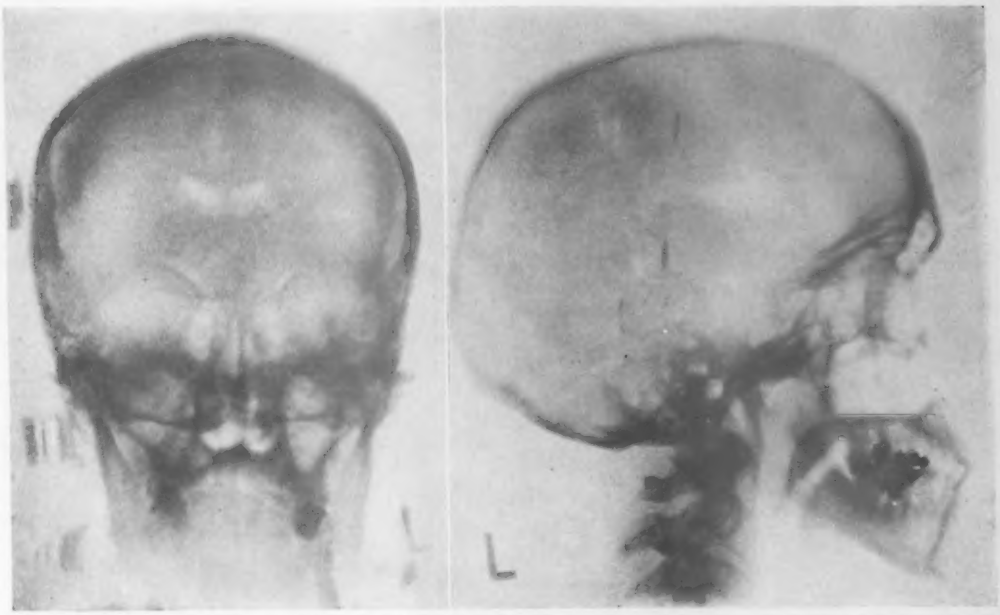

Fig. 31. Encephalograms taken without aid of the Bucky grid. Poor definition of air pathways; accurate interpretation impossible. To insure necessary detail the Bucky diaphragm must be used. (Pendergrass, 1928.)

Many cases have been out of bed the following day, with very little disturbance.

Although the severity of the headache and sweating, some weakness of the pulse and vomiting may appear to be alarming to the operator who first undertakes this procedure, if the intracranial pressure readings have been carefully observed, there need be no concern, as these symptoms pass off rapidly, and are usually associated to some degree with any change in intracranial pressure, or the introduction of air into the subarachnoid spaces.

The roentgenograms made after twenty-four and forty-eight hours have shown residual air in the ventricles, and over the cortex. Apparently absorption goes on slowly, and with the accumulation of air at the vertex, there is a definite sagging of the brain structures, with a tendency to collapse the ventricles (Figs. 28, 29 and 30). The air seen over the vertex in this period following encephalography strongly suggests that it has become extra-arachnoid, through a mechanism which is now being studied; the capsular space between the arachnoid villi and the dura. No proof has been offered to establish the exact presence of this air above the arachnoid, and we are unable to determine whether this is the effect of fluid over the convolutions, or its escape out of the subarachnoid space.

The exact significance of this finding will be the subject of a presentation in another paper.

ROENTGENOGRAPHIC TECHNIQUE

The apparatus and technique we have employed in making the roentgenograms have been described previously by Pendergrass (1928), but a few points require special mention. The essential feature of the method is the use of the vertically placed flat Bucky diaphragm. Flat roentgenograms made by the use of the old type plate or cassette changer *will not suffice* for the reason that the maximum amount of contrast (Fig. 31) between air and tissue shadow is needed in this work, and this is never possible in exposures made without the Bucky grid. In addition, roentgenograms must be as nearly technically perfect in every way possible, and none but the best should be used for diagnostic purposes.

Technically perfect roentgenograms imply the proper technique on the part of both the neurologist or neurological surgeon, and the roentgenologist. The

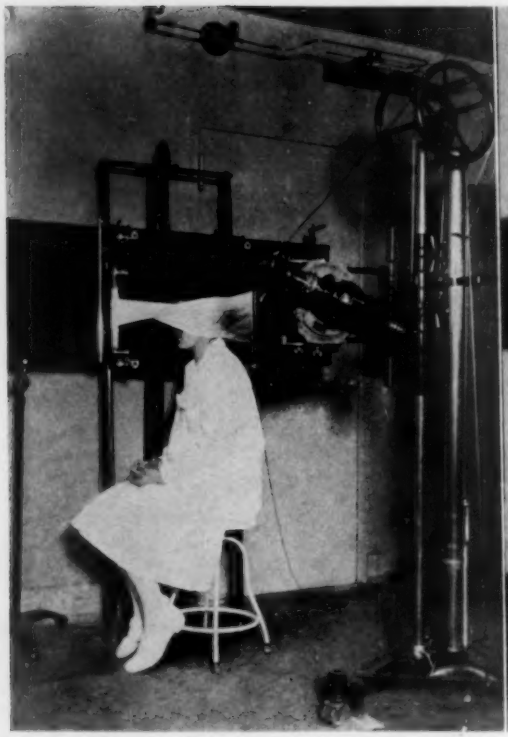

FIG. 32. Upright position of the patient during the roentgen exposures. Bucky diaphragm attached to horizontal plate changer. Fixation of the head for lateral stereoscopic films (horizontal shift). (Pendergrass, 1928.)

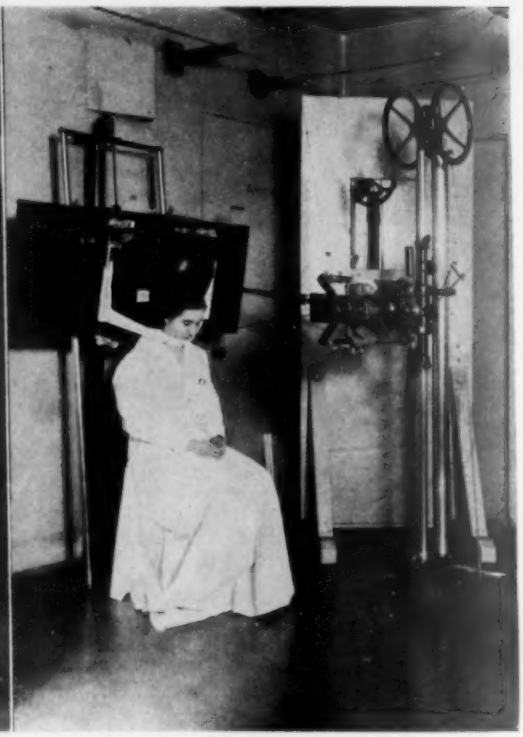

FIG. 33. Position of patient for anteroposterior stereoscopic roentgenogram. Note tilt of the horizontal plate changer forward with depression of the chin to eliminate the frontal sinuses (vertical shift). (Pendergrass, 1928.)

former must see to it that sufficient air is admitted and properly distributed for accurate diagnosis. Too little air or failure to manipulate the patient sufficiently and properly for its distribution will lead to misinterpretation and incorrect diagnosis. We cannot see how the neurologist can interpret faulty roentgenograms otherwise than by consciously or unconsciously attempting to make appearances correspond to clinical suspicions. Unfortunately, the attempt is all too frequently made, and very often because the roentgenologist knows too little about the subject to raise well-founded objections.

The time has now arrived when the roentgenologist must familiarize himself with brain anatomy and pathology so that he may be able not only to make his own interpretations, but also to decide when the operative part of the technique is unsatisfactory. There is no reason why this examination should not be carried out in the same manner as other difficult and complicated ones, by the proper correlation of clinical and roentgenological data. When the roentgenologist realizes that roentgenograms made of other portions of the body are technically unsatisfactory for diagnostic purposes, he reexamines the patient and does not rely on what he knows is mediocre and likely to be misleading. So in encephalography and ventriculography his word should have due weight with regard to the acceptance or rejection of improper work.

There are many points in roentgenological technique which go to make up technical perfection. Contrast and adequate exposure are of course essential. In making the anteroposterior and posteroanterior views, the greatest care is necessary with a rather restless and often almost unruly patient to have the central ray pass absolutely in the sagittal plane of the head, as otherwise there may result a very misleading asymmetry of the ventricles. Also, the head must be so tilted

Fig. 34. Two Pacchionian bodies showing their funnel-like openings into the subarachnoid space and their inclusion within the dural envelope (Winkelman).

Fig. 35. A Pacchionian body loaded with red blood cells from a distant cerebral hemorrhage. (Winkelman.)

forward that the lateral and third ventricles will be clear of the frontal sinuses. We prefer an up and down shift for stereoscopic views in this direction in order especially that there may be no lateral deviation of the ventricles shown in the single roentgenogram when it is so used for demonstration, or has to be employed for reproduction. Either the anteroposterior or posteroanterior view is made stereoscopically.

In making the lateral stereoscopic views, a side shift is preferred in order that the skull base may not interfere with clear vision of the ventricular system, and the basal cisterns. Also, a single roentgenogram is more satisfactory for demonstration purposes when so made.

The technique of exposure requires that the patient sit erect with his head against the Bucky cassette changer (Figs. 32 and 33). For the sake of safety, the tube target-film distance must be considerable—with our equipment it is 44 inches. This also lessens distortion due to projection of the shadows. This distance requires a stereoscopic shift of 5 inches. Each sagittal exposure requires approximately 200, and each lateral 120 milliampere-seconds, with double intensifying screen cassettes. While this may seem long, the distance cuts down the skin erythema possibility to a very low percentage. Careful records are kept of exposure in all head cases, and it is very easy to calculate just how much repetition is possible over a given period of time.

In order to economize apparatus and space, the same Bucky cassette changer is

Fig. 36. Sclerosis of the Pacchionian body found in a case of senile epilepsy. (Winkelman.)

used for encephalography that has been described previously for service in ventriculography (Pendergrass, 1928). This is suspended on the horizontal chest stereoscopic changer and can be very easily moved up and down. The tube stand is always in position for chest work and its position does not have to be altered for encephalography.

DISCUSSION

Encephalography is now being used to differentiate between obscure neurological diseases which involve the cerebral hemispheres, or the central nervous system, above the peduncles. It has led to the recognition of gross organic changes in the structure of the brain, where these changes have given few, if any symptoms, to indicate their presence or extent.

Epilepsy is a field which has been particularly fruitful in that about 80 per cent of "idiopathic" cases, in which encephalography has been undertaken, have shown gross abnormal changes, associated with this syndrome. In some of these patients the controlling of the fluid intake in such a way as to prevent accumulation of fluid over the cortex, as is evidenced by the large fluid pathways in the encephalogram, has led to a means of treatment by dehydration, and in some of these cases during the past year, certain relief of symptoms has occurred.

The operability of a case may depend to a large extent upon what the encephalogram shows, and certainly the exact area of involvement, as well as its characteristics and extent, should be demonstrable before subjecting the patient to the serious procedure of exploration. This is of great advantage, not only in dealing with actual supratentorial brain tumors, because of the possibility of disclosing the exact area of the lesion, but it has been invaluable in differential diagnosis where the question of operation has arisen, and where the encephalogram either indicated this procedure or demonstrated its futility.

Great stress must be placed upon carrying out of the proper technique as full drainage must be accomplished, and air reach all of the accessible pathways before a correct interpretation can be made. It is evident that insufficient drainage would lead to areas in which no air appeared and suggest a process which might not in reality exist.

The contraindications for encephalography are clear cut, and if observed, no danger should be attached to this procedure unless the operator knowingly assumes the added risk in the presence of gliomatous tumors. This added risk is sometimes justifiable because of the knowledge gained in defining the extent of the lesion and its accessibility to operation. The neurosurgeon may then plan his exploration with due regard to the factors disclosed. Certain cases have been benefited by the procedure in an unexplained way. This is true especially in post-traumatic headache, where 2 cases in our series, and several reported by Penfield, have found relief from a persistent headache, following the introduction of air. It has therefore been used as a therapeutic agent in a few cases, but the proportion which respond favorably to air injections for relief of headache, is still small.

The procedure has added a large number of new observations to our understanding of obscure neurological lesions, making diagnosis and prognosis more certain, and opening up new channels for investigation.

Encephalography has been the means of establishing and demonstrating the mechanism of pressure which has been discussed in this paper, the adequate understanding of which was not forthcoming until many observations on characteristic responses of cerebrospinal fluid pathways were correlated.

The safety of the procedure itself, when due regard to all factors in the cases have been considered, is indicated in Table 1.

It is evident that the mortality, which is less than 2 per cent, has reached this level because of its use in cases of brain tumor, and under conditions which were not favorable, or as a means of last resort in determining what might be done for a patient already almost moribund. It is to be expected that the development of its technique and use, so that it may be employed early instead of late, will give the desired information, before the element of risk has increased by the patient's progressing to a point of final dissolution.

In our experience, it has been undertaken between the ages of three months and eighty-four years, without danger. The one case in our series which died following encephalography, was a patient who was stuporous, hemiplegic and blind from the effects of a large frontal lobe glioma. The encephalogram disclosed the extent and location of the tumor. The

TABLE 1
MORTALITY IN ENCEPHALOGRAPHY

Author	No. Cases	Deaths	Remarks
Bingel, A., 1921–1927	300	3	Dural tumor, 15 hours; glioma, diabetes 24 hours; case of cerebellar tumor, 3½ hours.
Martin and Uhler, 1922	14	0	
Wrede, 1922	200	2	Hydrocephalus in 12 hours; fibroma of aqueduct, death 4 days.
Denk, M., 1922	318	2	Inoperable tumors; deaths not attributed to encephalography.
Mader, A., 1923	20	1	Moribund premature infant.
Jangling, 1924	39	3	One immediately, others 48 hours.
Fischer, 1925	36	1	Infant with hydrocephalus.
Rosanoff and Budinoff, 1925	100	0	
Wartenberg, 1926	13	0	No deaths that can be attributed to encephalography.
Sharp, 1926	65	2	Spinal meningitis cases, moribund at onset.
Fischer, M., 1927	18	0	
Tromner, 1927	100	3	One was alcoholic; 2 were paralytic.
Carpenter, E. R., 1927	40	0	
Strauss, 1927	96	2	One died 2 days, spongioblastoma, patient's disease; one died 24 hrs. cerebellar degeneration.
Friedman, Snow and Kasanin, 1928	47	0	
Frazier Clinic	26	0	
Fay	79	1	Large glioma, right frontal, moribund, died 3 days later.
Total	1529	20	1.2 per cent mortality

patient's rapid decline, just prior to the encephalogram, was followed by a similar progression after the air injection. The condition was recognized as hopeless and the patient died three days following encephalography. This can hardly be considered a death due to the procedure, but indicates even in extreme and hopeless cases, the possibility of its use to determine if the more formidable exploration should be undertaken.

The method of air injection which we have employed is similar to that used by Bingel, and also by Martin and Uhler, but is simplified somewhat in the discarding of cumbersome apparatus used to maintain a more constant equilibrium. The essential requirements for the air injection are two gold or nickoloid steel needles, a 20 c.c. syringe, and a mercury manometer with connections (Fig. 27). The careful regulation of pressure and especially the obtaining of initial and final pressures is important. Some operators have placed the patient in the sitting position from the start, but this we feel to be an added risk if spinal pressure has not already been noted in the prone position. If the pressure is found to be increased, the upright position of the patient favors a cerebellar hernia, should any attempt of removal of fluid be made at that time.

CONCLUSIONS

(1) Encephalography has proved to be an exact means of differential diagnosis, and of great value in determining gross cerebral changes found in observed or suspected intracranial disorders.

(2) Careful observance of the indications and contraindications as well as the technique of air injection and roentgenographic studies is necessary to insure a proper interpretation of the encephalogram.

(3) The relative safety of this procedure, as well as the simplicity of its accomplishment, justifies its wider use in those cases which require a more accurate means of diagnosis or localization and in which the indications for the procedure are clear cut.

(4) The interpretation of the encephalogram itself is dependent upon an adequate understanding of the cerebrospinal fluid circulation, the subarachnoid pathways, and close co-operation between the roentgenologist and the neurologist or the neurosurgeon.*

REFERENCES

ADSON, A. W., OTT, W. O., and CRAWFORD, A. S. A study of ventriculography. *Radiology*, 1924, ii, 65–73.

ALWENS, W., and HIRSCH, S. Diagnostic and therapeutic importance of endolumbar insufflation of air (encephalography). *München. med. Wchnschr.*, 1923, lxx, 41–44.

BAGLEY, C. Functional disturbances and organic alteration following the introduction of blood into the cerebrospinal fluid. Paper read before the Association for Research in Nervous and Mental Disease, Dec. 28, 1927.

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BASSOE, P., and DAVIS, CARL B. Two cases of brain tumor with ventriculography. *Arch. Neurol. & Psychiat.*, 1923, ix, 178–183.

BINGEL, A. (1921–1923) Zur Technik der intralumbalen Lufteinblasung, insbesondere zum Zwecke der "Enzephalographie." *Deutsche med. Wchnschr.*, 1921, xlvii, 1492. Intralumbare Lufteinblasung zur Höhendiagnose intraduraler extramedullärer Prozesse und zur Differentialdiagnose gegenüber intramedullären Prozessen. *Deutsche Ztschr. f. Nervenh.*, 1921, lxxii, 359–370. Encephalographie, eine Methode zur röntgenographischen Darstellung des Gehirns. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1921–1922, xxviii, 205–217. Neben- und Nachwirkungen bei Gaseinblasungen in den Lumbalkanal. *Deutsche Ztschr. f. Nervenh.*, 1922, lxxv, 230–249. Todesfälle nach Gaseinblasungen in den Lumbalkanal, beziehungsweise in die Gehirnventrikel. *Med. Klin.*, 1923, xix, 637–640.

BINGEL, A. Die röntgenographische Darstellung des Gehirns. *Klin. Wchnschr.*, 1922, i, 2191–2197.

BINGEL, A. Erfahrungen mit der Encephalographie. *Deutsche Ztschr. f. Nervenh.*, 1922, lxxiv, 121–129.

CARPENTER, E. R. Early indications and treatment of brain tumors. *Texas State M. J.*, 1924, xx, 247–251.

CARPENTER, E. R. Pneumoventriculography in localization of brain abscess. *Arch. Otolaryngol.*, 1925, i, 392–396.

CARPENTER, E. R. Early diagnosis and localization of brain tumors. *Radiology*, 1926, vi, 67–70.

CARPENTER, E. R. Surgical treatment of chronic headache and pain in the head. *Southwestern Med.*, 1926, x, 61–63.

CARPENTER, E. R. Encephalography, lumbar puncture and trephine methods. *Am. J. M. Sc.*, 1927, clxxiii, 333–342.

CESTAN and RISER. La ventriculographie cérébrale par la pneumorachie. *Bull. et mém. Soc. méd. d. hôp. d. Par.*, 1925, xlviii, 953–961.

DANDY, W. E., and BLACKFAN, K. D. An experimental and clinical study of internal hydrocephalus. *J. Am. M. Ass.*, 1913, lxi, 2216.

DANDY, W. E., and BLACKFAN, K. D. Internal hydrocephalus; an experimental, clinical and pathological study. *Am. J. Dis. Child.*, 1914, viii, 406–482.

DANDY, W. E. Ventriculography following the injection of air into the cerebral ventricles. *Ann. Surg.*, 1918, lxviii, 5–11.

DANDY, W. E. Röntgenography of the brain after the injection of air into the spinal canal. *Ann. Surg.*, 1919, lxx, 397.

DANDY, W. E. Ventriculography following the injection of air into the cerebral ventricles. AM. J. ROENTGENOL., 1919, vi, 26–36.

DANDY, W. E. Localization or elimination of cerebral tumors by ventriculography. *Surg., Gynec. & Obst.*, 1920, xxx, 329.

DANDY, W. E. Diagnosis and treatment of hydrocephalus resulting from stricture of the aqueduct of Sylvius. *Surg., Gynec. & Obst.*, 1920, xxxi, 340.

DANDY, W. E. The cause of so-called idiopathic hydrocephalus. *Johns Hopkins Hosp. Bull.*, 1921, xxxii, 67.

DANDY, W. E. The treatment of brain tumors. *J. Am. M. Ass.*, 1921, lxxvii, 1853.

DANDY, W. E. Diagnosis and treatment of hydrocephalus due to occlusion of foramina of Magendie and Luschka. *Surg., Gynec. & Obst.*, 1921, xxxii, 112.

DANDY, W. E. The space-compensating function of cerebrospinal fluid.—Its connection with cerebral lesions in epilepsy. *Johns Hopkins Hosp. Bull.*, 1923, xxxiv, 245–251.

DANDY, W. E., and ELMAN, R. Studies in experimental epilepsy. *Johns Hopkins Hosp. Bull.*, 1925, xxxvi, 40–49.

DANDY, W. E. Impressions of the pathology of epilepsy from operations. *Am. J. Psychol.*, 1927, vi, 519–522.

DAVENPORT, G. L. Ventriculography, its place in brain surgery. *Illinois M. J.*, 1923, xliv, 179–181.

DENK, W. Die Bedeutung der Pneumoventrikulographie (Encephalographie) für die Hirndiagnostik. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1923, xxxvi, 9–28.

DENK, W. Dangers of lumbar encephalography in the presence of cerebral tumors. *Zentralbl. f. Chir.*, 1923, l, 471–472.

DOYLE, A. S. Traumatic pneumocranium. AM. J. ROENTGENOL., 1921, viii, 73–75.

ELSBERG, C. A., and SILBERT, S. Changes in size and relation of the lateral ventricles in tumors of the brain. Preliminary report. *Arch. Neurol. & Psychiat.*, 1925, xiv, 489–501.

FAY, TEMPLE. Some factors in the mechanical theory of epilepsy, with especial reference to the influence of fluid and its control, in the treatment of certain cases. Presented before the American Psychiatric Society, June 5, 1928.

FISCHER, H. Beitrag zur Encephalographie. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1925, xxxiii (*suppl.*), 53.

FISCHER, M. Grenzen und Möglichkeiten der Encephalographie. *Arch. Psychiat. & Neurol.*, 1926, lxxix, 96–130.

FOERSTER, O. Encephalographische Erfahrungen. *Ztschr. f. d. ges. Neurol. & Psychiat.*, 1924–1925, xciv, 512–584.

FOERSTER, O. Zur operativen Behandlung der Epilepsie. *Deutsche Ztschr. f. Nervenh.*, 1926, lxxxix, 137–147.

FRAZIER, C. H., and PEET, M. M. Factors of influence in the origin and circulation of the cerebrospinal fluid. *Am. J. Physiol.*, 1914, xxxv, 268–282.

FRAZIER, C. H., and INGHAM, S. D. The action of glandular extracts on the secretions of cerebrospinal fluid. *Am. J. Physiol.*, 1915, xxxvi, 464.

FRAZIER, C. H., and INGHAM, S. D. A review of the effects of gunshot wounds of the head, based on 200 cases at U. S. General Hospital No. 11. *Arch. Neurol. & Psychiat.*, 1920, iii, 17–40.

FREMONT-SMITH, F. The nature of the cerebrospinal fluid. *Arch. Neurol. & Psychiat.*, 1927, xvii, 317–331.

FREMONT-SMITH, F., and KUBIE, L. S. The relation of human cerebrospinal fluid pressure to vascular hydrostatic pressure and to the osmotic pressure of the blood. Presented before the Association for Research in Nervous and Mental Disease, December, 1927.

FRIEDMAN, E. D., SNOW, W., and KASANIN, J. I. Experiences with encephalography via the lumbar route. *Arch. Neurol. & Psychiat.*, 1928, xix, 762–795.

GABRIEL. Ueber Enzephalographie. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxx (*Kongressheft II*), 65–66.

GRANT, F. C. Ventriculography; clinical experience based on series of 40 cases. *Arch. Neurol. & Psychiat.*, 1923, x, 154–166.

GRANT, F. C. Ventriculography; review based on analysis of 392 cases. *Arch. Neurol. & Psychiat.*, 1925, xiv, 513–522.

HERMANN, G., and HERRNHEISER, G. Encephalographiestudien. I. Schläfelappenatrophie bei halluzinierenden Paralytikern. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1925, xcvi, 730–736.

HOLMES, G. W. Intracranial aerocele following fracture of the frontal bone. AM. J. ROENTGENOL., 1918, v, 384.

JÜNGLING, O. Fortschritte auf dem Gebiet der Lokalisa-

tion von Hirngeschwülsten durch Ventriculographie nach Dandy. *Arch. f. klin. Chir.*, 1924, cxxxiii, 449–464.

Jüngling, O. Röntgenologisches von der 48 Versammlung der Deutschen ges. f. Chir., Berlin, April, 1924.

Jüngling, O. Lokalization der Hirntumoren mit der dandyschen Gasfullung der Hirnventrikel. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1924, xxxii, 143–144.

Kroll. Encephalographie. *Klin. Wchnschr.*, 1923, ii, 720.

Kubie, L. S. Changes in intracranial pressure during forced drainage of the central nervous system. *Brain*, 1928, li, 244–253.

Liberson, F. Apparatus for simultaneous displacement. *Arch. Neurol. & Psychiat.*, 1924, xii, 300–304.

Liberson, F. Value and safety of simplified method of pneumoencephalomyelography; preliminary report on use of a special apparatus in 40 cases. Am. J. Roentgenol. & Rad. Therapy, 1926, xv, 231–241.

Locke, C. E. Jr. Studies of casts of the cerebral ventricles. *Arch. Neurol. & Psychiat.*, 1926, xv, 588–596.

Luckett, W. H. Air in the ventricles of the brain, following a fracture of the skull. *Surg., Gynec. & Obst.*, 1913, xvii, 237–240.

Mader, A. Enzephalographische Erfahrungen im Säuglingsalter. *Med. Klin.*, 1923, xix, 1427–1428.

Martin, C. L., and Uhler, C. Roentgenography of intracranial passages, following spinal air injections. Am. J. Roentgenol., 1922, ix, 543–549.

May, R. J. Report of case showing air within the cranial cavity. Am. J. Roentgenol., 1919, vi, 190.

Merrill, A. S. Diagnosis of brain tumor by pneumoventriculography. Am. J. Roentgenol., 1921, viii, 188–190.

McConnell, A. A. Ventriculography as an aid in localization of intracranial tumors. *Brit. M. J.*, 1923, ii, 796–798.

Pendergrass, E. P. A new arrangement of the Bucky diaphragm for ventriculography. Am. J. Roentgenol. & Rad. Therapy, 1927, xvii, 358–359.

Pendergrass, E. P. New arrangement of the Bucky diaphragm for encephalography. Am. J. Roentgenol. & Rad. Therapy, 1928, xix, 482–484.

Penfield, W. G. Cerebral pressure atrophy. Read before the Association for Research in Nervous and Mental Disease, December, 1927.

Potter, H. E. Case of hydro-pneumo-cranium, with air in ventricles. Am. J. Roentgenol., 1919, vi, 12–16.

Reichman, V. Zur Klinik insbesondere zur Diagnose der Pachymeningitis Hemorrhagica Interna. *Deutsche Ztschr. f. Nervenh.*, 1924, lxxxi, 304–320.

Schott, E., and Eitel, J. Uber die Encephalographie nach Bingel. *Deutsches Arch. f. klin. Med.*, 1922–1923, cxli, 16–29.

Schüller, A. Zur Röntgendiagnose der intrakraniellen Affektionen mit Hilfe des dandyschen Verfahrens. *Wien. klin. Wchnschr.*, 1922, xxxv, 709–711.

Schuster, P. Demonstration zweier Röntgenplatten der Lufteinblasung. *Zentralbl. f. d. ges. Neurol. u. Psychiat.*, 1923, xxxii, 58.

Schuster, J. Einiges zur röntgenographischen Darstellung des Gehirns. *Deutsche Ztschr. f. Nervenh.*, 1923, lxxx, 129–149.

Schuster, J. Zur operativen Therapie der Epilepsie. Encephalogramme bei Epilepsie, gleichzeitig ein weiterer Beitrag zur Wirkung der Hyperventilation. *Arch. f. Psychiat.*, 1926, lxxviii, 214–237.

Schuster, J. Ueber die Verschiedenheit der Bilder bei Wiederholter Encephalographischer Untersuchung des Gehirns. *Arch. f. Psychiat.*, 1926, lxxvii, 532–546.

Sharpe, W. Intracranial hemorrhage in the new-born. *J. Am. M. Ass.*, 1923, lxxxi, 620–624.

Sharpe, W., and Maclaire, A. S. Intracranial hemorrhage in the new-born. *Surg., Gynec. & Obst.*, 1924, xxxviii, 200–206.

Sharpe, W., and Maclaire, A. S. Further observations of intracranial hemorrhage in new-born; significance of yellow spinal fluid and of jaundice in these cases. *Am. J. Obst. & Gynec.*, 1924, viii, 172–186.

Skinner, E. H. Intracranial aerocele. *J. Am. M. Ass.*, 1916, lxvi, 954.

Stewart, W. H. Fracture of the skull with air in the ventricles. Am. J. Roentgenol., 1913, i, 83–87.

Strauss, I. Personal communication, 1928.

Taterka, H. Die Förderung der Hirndiagnostik durch die Encephalographie. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1924, xcii, 418–432.

Trömner, E. Wert und Unwert der Encephalographie. *Zentralbl. f. d. ges. Neurol. u. Psychiat.*, 1927, xlvi, 550.

Tschugunoff, S., Budinoff, D., and Rosanoff, M. Zweiter russischer Röntgenologen und Radiologenkongress. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1925, xxxiii, 601.

Waggoner, R. W. Encephalography. *Am. J. M. Sc.*, 1927, clxxiv, 459–466.

Wartenberg, R. Encephalographische Erfahrungen. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1924–1925, xciv, 585–628.

Wartenberg, R. Encephalography and Myelography. *Arch. f. Psychiat.*, 1926, lxxvii, 507–531.

Weed, L. H. The cells of the arachnoid. *Johns Hopkins Hosp. Bull.*, 1920, xxxi, 343–350.

Weed, L. H. Cerebrospinal fluid. *Physiol. Rev.*, 1922, ii, 171–203.

Weed, L. H. Experimental studies of intracranial pressure. Presented before the Association for Research in Nervous and Mental Disease, December, 1927.

Weed, L. H., and McKibben, P. S. Experimental alteration of brain bulk. *Am. J. Physiol.*, 1919, xlviii, 531–558.

Weed, L. H., and McKibben, P. S. Pressure changes in the cerebrospinal fluid following intravenous injections of solutions of various concentrations. *Am. J. Physiol.*, 1919, xlviii, 512–530.

Weed, L. H., and Wegeforth, P. Experimental irrigation of the subarachnoid space. *J. Pharm. & Exp. Therap.*, 1919, xiii, 317–334.

Weed, L. H., and Hughson, W. Systemic effects of intravenous injections of solutions of various concentrations with especial reference to cerebrospinal fluid. *Am. J. Physiol.*, 1921, lviii, 53–84.

Weed, L. H., and Hughson, W. Intracranial venous pressure and cerebrospinal fluid pressure as affected by intravenous injection of solutions of various concentrations. *Am. J. Physiol.*, 1921 lviii, 101–130.

Weigeldt, W. Technique and interpretation of ventriculograms. *München. med. Wchnschr.*, 1922, lxix, 1764–1767.

Weigeldt, W. Die Bedeutung der Lufteinblasung für Hirn- und Rückenmarksdiagnostik. *Deutsche Ztschr. f. Nervenh.*, 1923, lxxvii, 165–173. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxx (*Kongressheft II*), 63–65.

Weimann, W. Zur Frage der akuten Ammonshornveränderungen nach epileptischen Anfällen. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1924, xc, 83–88.

Wideröe, S. Ueber die diagnostische Bedeutung der intraspinalen Luftinjektionen bei Rückenmarksleiden, besonders bei Geschwülsten. *Zentralbl. f. Chir.*, 1921, xlviii, 394–397.

Wyatt, O. S. Cerebral pneumography as an aid in early diagnosis of hydrocephalus. *Journal-Lancet*, 1923, xliii, 625–628.

DISCUSSION

DR. FRANK R. TEACHENOR, Kansas City, Mo. As Dr. Fay has stated, encephalography, and more particularly ventriculography, has been used for the past eight or ten years. As it happens, I have had more experience with ventriculography than with encephalography. There are two particular advantages that I see in encephalography over ventriculography; first, that it requires no operation in the form of trephining of the skull in order to get the air into the ventricles. The patient may submit to this procedure but would hesitate to submit to an operation for trephining which we have to do in ventriculography. On the other hand, the patient is not in an entirely comfortable position for air to be introduced in encephalography. At each injection of air the patient complains of headache, which is apparently quite severe.

The second advantage is that the encephalogram gives us an additional visualization of the subarachnoid pathways which we do not get in the ventriculogram.

The authors have stated that in patients having a pressure over 20 or 25 mm. Hg they hesitate to use encephalography, and in the majority of those cases there would be most likely a posterior fossa lesion in which the encephalogram may give comparatively little information over the ventriculogram, which would be a great deal safer, so that the combination of ventriculography and encephalography will undoubtedly permit more accurate diagnoses.

DR. CHARLES L. MARTIN, Dallas, Tex. I am particularly interested in this method since we have been using it for seven or eight years, and I simply want to ask one or two questions. I understood Dr. Fay to say that the obliteration of the subarachnoid spaces, as they have found them, was due to secondary hemorrhage. I should like to ask if there are not other causes. We have attributed them to meningitis. What other lesions would obliterate the subarachnoid spaces? Has this procedure been used as a therapeutic method? We have had two cases of chronic headache and the headache completely disappeared after the injection of air. What is the explanation of this?

I should also like to ask whether, in all the cases of epilepsy which they have examined where there was dilatation of the subarachnoid spaces, if this was a constant finding.

I should also like to ask Dr. Pancoast about his method of examining infants and children. This method apparently could not be used on babies, but that is apparently where we ought to use it, in looking for trauma after birth. We did most of our work on children. We did not make any of our examinations of children in a sitting position, and yet we got all of the ventricles pretty well filled.

With regard to the technique of the injection, we have never used the manometer when injecting these cases although we have been careful not to inject such cases as Dr. Fay has warned against. Our method has been to withdraw 10 c.c. of fluid and put in 9 c.c. of air. I want to ask Dr. Fay whether there would be any danger of producing pressure high enough to do harm.

DR. R. R. NEWELL, San Francisco, Calif. I would like to ask Dr. Fay if he has observed any instances in which the intracranial pressure increased a few hours or a day or so after putting an amount of air into the cranium by this method.

DR. C. J. JOHANNESSON, Walla Walla, Wash. I should like to know about the interpretation, or what guidance we have, in a case of unknown causes of lesion, unknown cord lesions.

DR. FAY (closing). I appreciate Dr. Teachenor's discussion because I have employed both ventriculography and encephalography and found, as he has pointed out, that they are complementary procedures. One is never going to replace the other, and it is important that the contraindications be followed. The choice of the wrong procedure under any contraindication, that is, the use of ventriculography when encephalography should be indicated, is to increase the risk. To undertake encephalography in the presence of contraindications where ventriculography is indicated is to court disaster. So they are complementary procedures and should be maintained as a unit and as a whole, especially among the neurosurgeons who are qualified to do ventriculography.

In reply to Dr. Martin's question about hemorrhage, of course we have only touched upon that question here because of the time at our disposal. In our paper we have covered the pathological processes that are to be considered. We may find encephalitis as a cause, and post-traumatic cerebritis as a cause; distant hemorrhages, even hemorrhage following lumbar puncture, must be carefully considered. We are treating the post-traumatic head cases by draining the spinal fluid until we get no more blood, twice a day if necessary, because of the fear that if we leave the blood, six months to two years later there will be a post-traumatic neurosis and post-traumatic epilepsy. The other conditions to be considered are localized inflammations of various kinds, encephalitis and meningitis.

In one other case of post-traumatic neurosis, my colleague claimed it to be hysteria because of relief of headache afforded by encephalography. I believe there is a therapeutic value in a very small percentage of cases. We do not know the exact cause, but I do not believe the cause ascribed by Penfield, that the air stretches the adhesions and gives better drainage, is acceptable. I cannot visualize the adhesions attached to the cortex as being stretched without producing a subarachnoid hemorrhage, and certainly that is not the finding so far. There is probably another explanation which we have not found.

The question of epilepsy comes up. This has brought up a problem which you will soon find published, as I presented these findings in June before the American Psychiatric Society. At that time I took up the entire pathology as we have found it related physiologically and to this subject of encephalography. Rowntree found, experimentally, that he could take normal animals and introduce large quantities of water by a stomach tube and produce generalized convulsive seizures in four to five hours. Weed produced convulsive seizures in thirty-five minutes to one hour and fifteen minutes if he introduced a hypotonic solution in large quantity intravenously. If the fluid is strictly introduced into the cisterna magna within the subarachnoid space we have produced a convulsive seizure in six minutes. If the needle is left in the cisterna magna allowing fluid to drain during the introduction of water by mouth or vein, Kubie has noted that the animal will not have a convulsive seizure.

Therefore, in cases of grand mal when we came to correlate these and the roentgen-ray findings a year ago last June we started some epileptics on fluid limitation cutting them down from 8 to 20 ounces a day total fluids, milk, tea, coffee, water, soup and juices. By dehydration methods we have a few cases that are now coöperating, 17 in all, who during fifteen months remained free from grand mal attacks. We have selected cases which we found by encephalography to have increased subarachnoid fluid. They are limited to those who can coöperate and are too few to draw any conclusions from.

It is interesting that we may produce the convulsive state by excessive fluid and that we can control some of them by dehydration. We find that fluid may be a predisposing factor; it is not the cause of the convulsion.

In regard to pressure readings, I believe it is important. Dr. Martin brings up the point of replacement of air with fluid on a volume per volume method. I believe it is important to know the initial pressure and the final pressure, and that answers Dr. Newell's question about the pressure following the procedure. You know when you leave the patient that there is 10 mm. of intracranial pressure. In our series where we have regulated that, we have never had to go back and do a lumbar puncture. Before, when we were not taking the pressures, we have sometimes had to go back and withdraw the air because of the low pulse and some signs of respiratory disturbance. If you use the pressure for pressure method, I believe it will be a safer procedure.

In reply to Dr. Johannesson's question on the introduction of air for localization of cord tumor, Bingel pointed this out in 1922 in differentiating a cord block by introducing air and determining roentgenologically the level of the block. That method has been used but we now place more dependence on the Queckenstedt test. The Queckenstedt test, where there is a block sufficient to stop air, is diagnostic, and that is done by simply a lumbar puncture and pressure on the jugulars. If we get a transmission of pressure through the fluid around the cord by compressing the jugular and increasing the intracranial pressure we know the cord canal is open. If we do not get that pressure we know there is an obstruction or delay, and that the canal is closed.

BONE CHANGES IN RAYNAUD'S DISEASE

AS REVEALED BY THE ROENTGEN RAY

BY KARL KORNBLUM, M.D.

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PHILADELPHIA, PENNSYLVANIA

FEW diseases present such variable clinical manifestations as Raynaud's disease. Because of this fact it is difficult to be certain of the diagnosis. Since Raynaud's description of this disease in 1862, little has been added to its etiology or pathology. Clinically, however, many new signs and symptoms have been recognized. Cases that correspond in all respects to the classical description given by Raynaud are rather rare. This, unquestionably, has frequently been an obstacle in the way of early diagnosis. The outstanding fact to be kept in mind is the point emphasized by Raynaud, that this condition "has its cause in a vice of innervation of the capillary vessels." This is the only feature that all conditions which can properly be called Raynaud's disease must have in common. Thus, regardless of the clinical manifestations, the diagnosis rests primarily upon the exclusion of demonstrable vascular changes or organic disease of the circulatory system. We are dealing, therefore, with a disease which has as its basis an instability of the vasomotor system. This instability, while it may be general, only manifests itself locally. These local areas need not necessarily be symmetrical.

Raynaud's disease is about twice as common in women as in men. The age incidence is between eighteen and thirty years. While the exact cause is not known, certain conditions are regarded as predisposing factors such as exposure to cold, psychic shock and mental strain. Other conditions, such as heredity, neurotic temperament, anemia, syphilis and malaria, upon which considerable stress has been laid, have come to be regarded by recent investigators as of little or no significance.

The clinical manifestations are, first, those of vasomotor disturbances. These are followed later by trophic disorders and gangrene. The onset of symptoms may be fairly sudden or may, on the other hand, be quite insidious. The first symptoms are those of local syncope in the hands or feet, more frequently the former. The fingers or toes become pale and cold. Paresthesia, anesthesia or occasionally pain is present and at times there may be disturbances in the sense of touch. After a variable time, the syncope is replaced by local asphyxia in which the parts previously pallid, become cyanotic. Swelling usually accompanies this stage. Finally, a hyperemia occurs in which the affected parts become quite red, the condition sometimes simulating erythromelalgia. While this probably is the usual sequence of events these symptoms may at times occur in the reverse order and it is not uncommon that one or more of the phenomena are entirely absent. The symptoms subside in much the same manner as they start. These attacks occur at irregular intervals of hours, days or weeks and are frequently initiated by some definite predisposing factor. The condition may remain stationary for a long period of time and may never pass beyond this stage, the patient eventually recovering.

In more serious cases the disease becomes progressively worse, the vasomotor phenomena giving way to trophic disturbances leading to gangrene. This may start as a small bleb at the tip of one finger which later develops into a black necrotic area. Spontaneous healing frequently occurs leaving a permanently contracted cicatrix. Gangrene may occur subsequently with involvement of other areas as well. Shedding of the nails is not uncommon. Although the gangrenous areas frequently are limited to the fingers or toes they may occur anywhere on the body, the nose and ears being common locations. Likewise, the necrotic areas which are usually small, may be at times quite extensive, as occurred in a case recently reported by Moses.[5] These necrotic patches are usually

confined to the superficial soft parts but the deeper structures may be involved also, occasionally quite independent of the superficial structures as in the case reported by Monahan.[4] Gangrene in Raynaud's disease, while usually of the dry type, may be of the moist variety also. When the stage of gangrene has been reached it usually is necessary to resort to multiple amputations.

Among the rarer phenomena that occur during the stage of trophic disorders are certain changes that take place in the bones. The following case, a patient from the neurological service of Dr. W. G. Spiller, University Hospital, is illustrative of this condition.

J. M., male, aged thirty-eight, was admitted to the hospital, January 4, 1928, with a chief complaint of burning and stinging of the fingers and toes.

History Present Illness. The patient was in good health until five years ago. At that time he was working in Florida picking oranges. It was in early Winter when, without apparent cause, the great toe of the left foot became pale and numb. This lasted for several days after which the pallor was replaced by a redness and the toe became quite painful and burning. This condition was gradually replaced by a bluish discoloration leading to gangrene, so that an amputation had to be done. The patient was then well for a year. At about the same time the following year and each succeeding year since, there has been a recurrence of such symptoms in the left foot, but further amputations in this foot have not been necessary. Two years ago the right hand became involved and last year the little finger of this hand was amputated. This Winter for the first time the right foot and the left hand have become affected. Some of the nails have been lost spontaneously. Pain in the affected parts has been quite severe at times. The condition has not been progressive in the various parts involved, the symptoms subsiding in one member and becoming worse in another. For the past two years the patient's memory has been failing and during the last year he has complained of attacks of dizziness and headaches. Recently there have been shooting pains up the legs to the knees and hips. In addition the patient has attacks of epigastric pain, occurring at night, during which he occasionally vomits.

Past History. He had "water on the brain" when a baby. Denies venereal diseases. No other diseases or operations.

Family History. Father died of tuberculosis. Mother living but has had a "stroke." Five sisters living.

Social History. Patient never went to school. Has no special occupation. He is single. Does not use drugs or alcohol.

Physical Examination. Blood pressure, 120/80 in both arms. Patient is of low mentality. The head is grossly negative. There is poor oral hygiene with many decayed and unextracted roots. Heart, lungs and abdomen are negative.

Extremities. The little finger of the right hand has been amputated. The skin over the tips of the fingers is dry and feels as if it were loose from the underlying tissues. There is tenderness over the tips of these fingers and they are red and swollen.

On the left hand, the tip of the third finger is black to the base of the nail.

The right foot shows a loss of the nail on the little toe and a dark patch on the plantar surface of the great toe. The toes are dry and firm, slightly red and swollen.

On the left foot the great toe has been amputated, the nails of the fourth and fifth toes are atrophic. There are scabs covering several ulcers on both feet.

The usual laboratory examinations were entirely negative. A roentgen examination of the hands and feet revealed destruction of the distal portion of the distal phalanges of the first, second and third fingers with amputation of the little finger of the right hand. In addition, there are several small rarefied areas in the distal ends of several of the phalanges and heads of the metacarpals. The left hand also shows a few of these small rarefied areas but no involvement of the distal phalanges. The feet were negative except for amputation of the distal phalanx of the great toe of the left foot.

Bone changes in Raynaud's disease have been described by Assmann,[1] Borak,[2] Buerger,[3] and Monahan.[4] The latter reports a most unusual and interesting case showing marked bone involvement with actual loss of bone without a commensurate involvement of the adjacent soft tissues. The usual roentgenological features are a loss of a part or of an entire terminal phalanx of one or more fingers or toes. The condition is most characteristically and frequently seen in the fingers. The first changes are those of bone atrophy in the affected phalanges with a gradual disappearance of the expanded tip. The process may become arrested at this stage

and remain stationary. On the other hand, the condition may progress until the entire phalanx has disappeared. The different fingers may show the process in different stages of development. While these changes are usually limited to the terminal phalanges it has been reported that atrophic changes are to be found in the other phalanges as well and that restitution occurs in these bones with recovery from the disease. Even a partial destruction of the metatarsal bones has been reported.[4] These latter changes, however, are not the usual ones encountered.

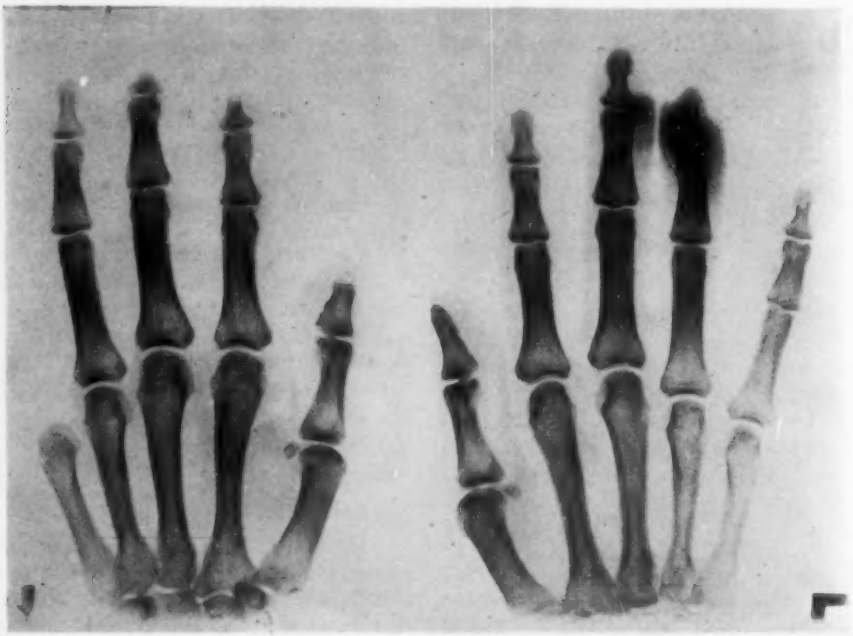

FIG. 1. Bone changes in Raynaud's disease. A roentgenogram showing the partial destruction of the terminal phalanges.

Roentgenograms (Figs. 1 and 2) of the case here reported show destruction of the distal phalanges of the thumb, index and middle fingers of the right hand. These changes are the ones considered characteristic of this disease. In addition, atrophic changes are to be noted in a number of the phalanges and metacarpals. These are represented by small punched-out areas at the ends of the bones. They are best seen in the heads of the second and third metacarpals of the right hand in the lateral view. These latter changes are in no way characteristic of Raynaud's disease as they are frequently encountered particularly in atrophic arthritis.

It has been stated that the bone changes as revealed by the roentgen ray are pathognomonic for Raynaud's disease. We have found identical changes occurring in the bones in scleroderma and leprosy and changes quite similar have been reported by Ström[6] as occurring in psoriasis. Scleroderma in many respects resembles Raynaud's disease and in the early stages one disease cannot readily be differentiated from the other. The question has arisen as to whether or not the two conditions are not different stages of the same process. If this is true it is only natural that the bone manifestations should be identical.* Leprosy, however, being due to a definitely known infective agent and yet showing a similar type of bone involvement to that found in Raynaud's disease makes it highly probable that these bone changes are in no manner specific. The osseous involvement in psoria-

* Dr. Louis Edeiken, Philadelphia, has reported recently a series of cases of scleroderma in which he found calcareous concretions in the soft tissues of the terminal phalanges accompanying the bone absorption. As far as is known this appears to be specific for scleroderma and serves to differentiate it from other similar conditions.

sis differs from these other conditions in that there is a concomitant arthropathy. Accompanying the disappearance of the distal portion of the terminal phalanges, as found in Raynaud's disease, there is also an involvement of the interphalangeal joints which consists of a destruction of the cartilage along with the adjacent portion of each neighboring bone.

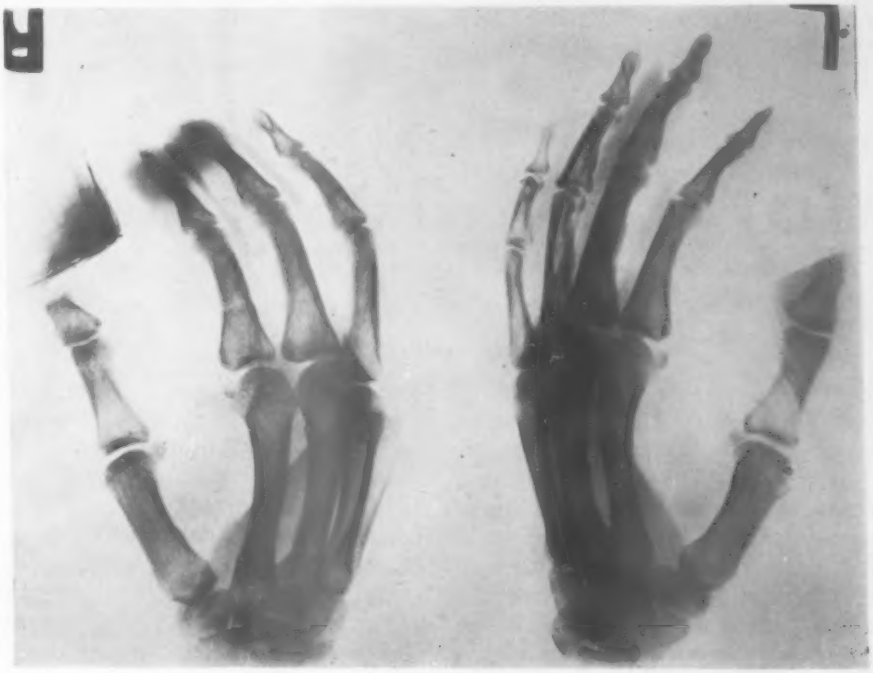

Fig. 2. Bone changes in Raynaud's disease. Lateral view of hands. Note the rarefied areas in the heads of the metacarpals.

The pathological changes found in the bones in Raynaud's disease are probably a part of the same general tissue starvation that results in sclerosis and gangrene of the overlying soft parts. Some of it may be a pressure atrophy from the adjacent hard indurated tissues. It is conceivable, of course, that the same vascular abnormalities that are responsible for the soft tissue gangrene may involve the nutrient vessels of the bones giving rise to atrophy and their gradual disappearance. This would seem to be the explanation in those cases where the bone changes are more extensive than could be accounted for by the soft tissue involvement.

The assertion has been made that the roentgen-ray appearance of the bones in Raynaud's disease is of diagnostic value. While it is true that the appearance is more or less characteristic, we do not regard these findings as aiding materially in the diagnosis. The bone changes as described occur relatively late in the disease, usually at a time when the clinical symptoms are so marked that the diagnosis is no longer in doubt. Also, as mentioned above, the roentgenological features are not pathognomonic for Raynaud's disease.

It is probable that the bone changes in Raynaud's disease are more common than is at present realized. A roentgen examination is not usually included in the routine laboratory studies made in this disease, so it is not unlikely that some cases that have bone changes go undetected. In the cases that have been reported the disease had already advanced to the stage of gangrene. It is not impossible that patients examined by means of the roentgen ray in the stage of vasomotor phenomena might reveal early changes in the bones that in themselves would suggest Raynaud's disease. These findings considered

in correlation with the clinical manifestations might be sufficient to establish the diagnosis of Raynaud's disease at a time when the diagnosis is usually much in doubt.

REFERENCES

1. Assmann, H. Die Röntgendiagnostik der inneren Erkrankungen. F. C. W. Vogel, Leipzig, 1921.
2. Borak, J. Zur Pathogenese und Therapie der Raynaudschen Krankheit. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1927, iii, 1–16.
3. Buerger, L. Nelson's Loose Leaf Medicine, Vol. vi, p. 719.
4. Monahan, J. J. Raynaud's disease; limitations of classical picture as a guide to diagnosis; report of case showing extensive bone involvement. *Am. J. M. Sc.*, 1926, clxxi, 346–358.
5. Moses, H. M. Problems in diagnosis. Case ii. Raynaud's disease, central nervous system involvement. *Med. Clin. N. Am.*, 1928, xi, 835–844.
6. Ström, S. A case of arthropatia psoriatica. *Acta radiol.*, 1921–1922, i, 21–25.

RECURRENT MASSIVE COLLAPSE OF THE LUNG DUE TO A BENIGN INTRABRONCHIAL TUMOR

BY HOWARD E. ASHBURY, M.D.

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THE observation of a case of recurrent massive collapse of the lung due to an intrabronchial tumor during successive stages of partial and complete atelectasis, offered an unusual opportunity for clinical and roentgen study. The etiology was known to be bronchial obstruction during the greater portion of the time that the case was under treatment. I wish to make special reference to the changes in intrapleural pressure which were present and the prompt relief of symptoms by air injections into the pleural cavity on the affected side; a phase of the subject, which as far as I have been able to find out, has not been discussed in roentgen literature, and by only three authors, Habliston,[7] Farris[4] and Elkin[3] in general medical literature. A recent study by Habliston, of intrapleural pressure in massive collapse of the lung, made after considerable experience in the production of artificial pneumothorax in the treatment of tuberculosis, controlled by water and mercury manometer pressure readings, offers a logical explanation of the physical and roentgen findings which take place in massive collapse of the lung.

In a normal individual, pulmonary expansion and the normal relationship of the thoracic organs are maintained by atmospheric pressure exerted intrapulmonarily via the trachea and the suction equally exerted in both pleurae by negative pressure. The average normal intrapleural pressure varies with respiration between −40 and −70 mm. of water (Fig. 1), or −2.54 and −5 mm. of mercury. A release of this suction by the entrance of air into the pleural cavity is followed by collapse of the lung as in pneumothorax. The lung, through its elasticity and recoil, contracts away from the chest wall; simultaneously the normally existing negative pressure falls or becomes positive, and true collapse of the lung results (pneumothorax); but if the free passage of air in and out of the lung is prevented by bronchial obstruction, or by some other cause, the pulmonary air is absorbed and the negative pleural pressure rises rapidly on the affected side, (often as high as −450 mm. water manometer reading, depending upon the area of lung involved), and atelectasis results. As the alveolar air is more completely absorbed, the vacuum or suction normally present is so increased that displacement of the heart, mediastinum and diaphragm takes place toward the affected side of the pulmonary lesion. So great may this suction be, that acute emphysema of the good lung occurs; cyanosis and dyspnea develop because of the lessened gaseous exchange in the overdistended lung. A vicious circle is now established; bronchial obstruction, absorption of alveolar air, atelectasis of the lung tissue, increase in the intrapleural negative pressure, which

in turn can only draw the obstructing media more firmly into the bronchus, and the affected lung is drawn tightly against the chest wall. On this basis, the term collapse, as applied to atelectasis, is misleading. Coryllos and Birnbaum suggest the term apneumotosis, which I believe is more appropriate.

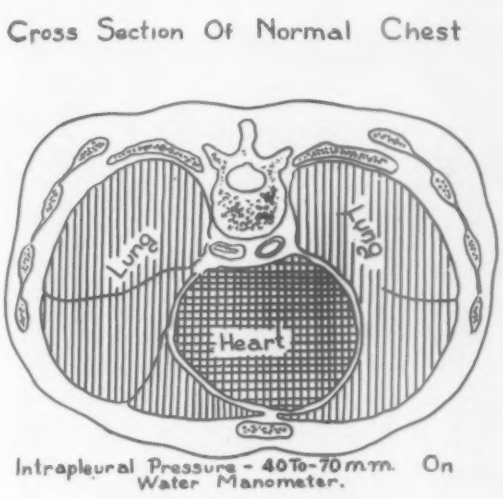

Fig. 1. (From Habliston.)

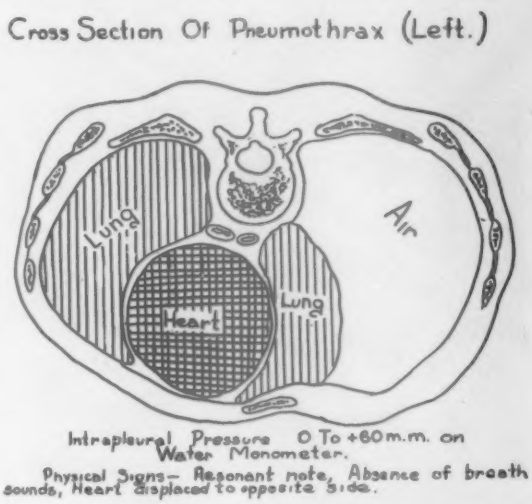
Cross Section Of Pneumothrax (Left.)
Lung
Air
Heart
Lung
Intrapleural Pressure 0 To +60 m.m. on Water Manometer.
Physical Signs- Resonant note, Absence of breath sounds, Heart displaced to opposite side.

Fig. 2. (From Habliston.)

Because of Gwyn's suggestion that the intrapleural pressure of the contralateral side might be of value, pressure of both sides was taken in one of Habliston's cases by using a water manometer on the unaffected side at the same time that the reading on the affected side was taken with a mercury manometer. As was anticipated, the intrapleural pressure on the unaffected side was within normal limits, varying between −40 and −80 mm. of water. On the affected side, a tremendous increase in negative pressure was recorded, varying on deep inhalation and expiration between −337.5 and −432 mm. of water (Fig. 3), with a mean negative pressure of −378; mercury reading −25 to −32, mean −28 mm. Habliston has reported 4 cases of apneumotosis due to different etiological factors, in each of which a marked increase in intrapleural negative pressure was demonstrated, the 4 cases broadly representing an example of each of the four principal etiological causes of massive collapse, viz.:

(*a*) Obstruction of the bronchus from within by an intrabronchial tumor; case reported.

(*b*) Obstruction of the bronchus from without by an aneurysm of the thoracic aorta, which obstructed the left main bronchus and later ruptured into the bronchus.

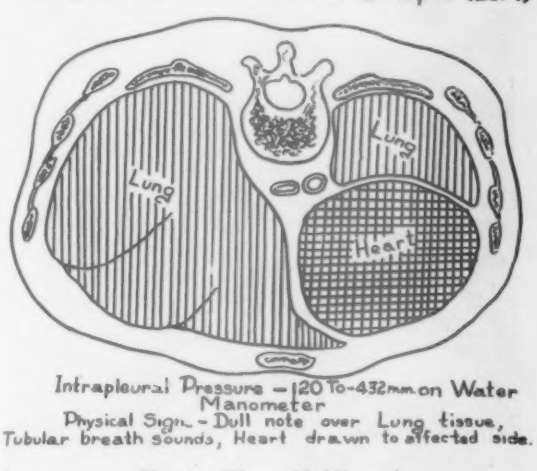
Cross Section of Massive Collapse (Left)
Lung
Lung
Heart
Intrapleural Pressure -120 To -432 m.m. on Water Manometer
Physical Sign - Dull note over Lung tissue, Tubular breath sounds, Heart drawn to affected side.

Fig. 3. (From Habliston.)

(*c*) Postoperative or post-traumatic reflex nervous phenomena. A severe injury to the pelvis and thigh with massive collapse.

(*d*) Chronic inflammatory pulmonary disease. Patient developed massive collapse during the course of a chronic pulmonary

tuberculosis of four years' standing; symptoms relieved by artificial pneumothorax.

Farris[4] reports 7 cases of atelectasis and one case of massive collapse. Among his conclusions, he says that atelectasis of the lung is a much more common condition than is usually recognized and the causes are numerous:

(1) Fibrosis of the lung and atelectasis of the lung are frequently confused (as was done at first in the case I am reporting).

(2) The negative pressure of atelectasis can produce intense cardiac distress.

(3) The heart may be displaced so close to the chest wall in the axilla, and the roentgen shadow be so dense and homogeneous that the position of the heart is not recognized and, as a consequence, it may be punctured on aspirating the chest.

(4) Pneumothorax treatment should be instituted in cases of atelectasis to give at

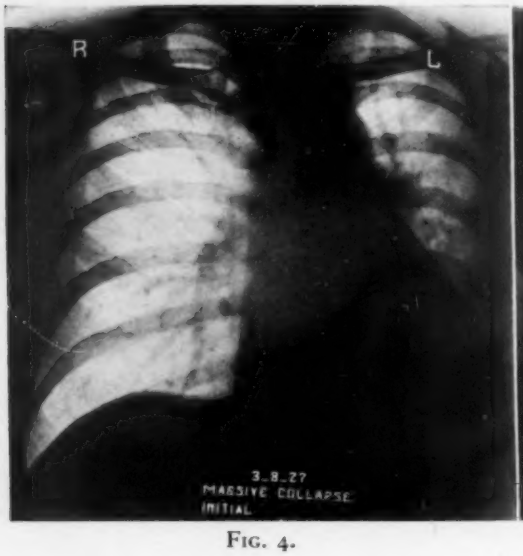

Fig. 4.

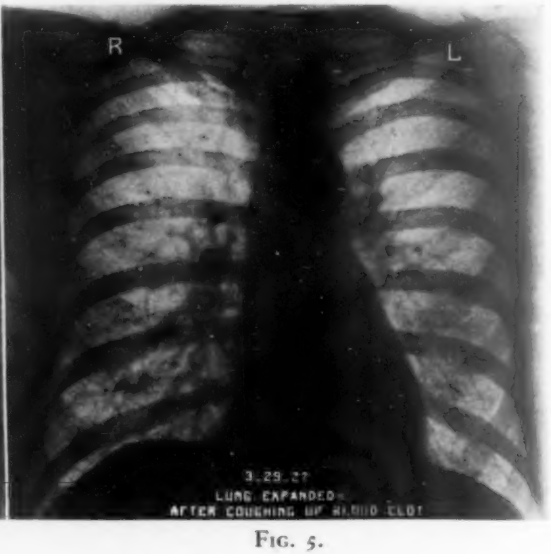

Fig. 5.

Fig. 6.

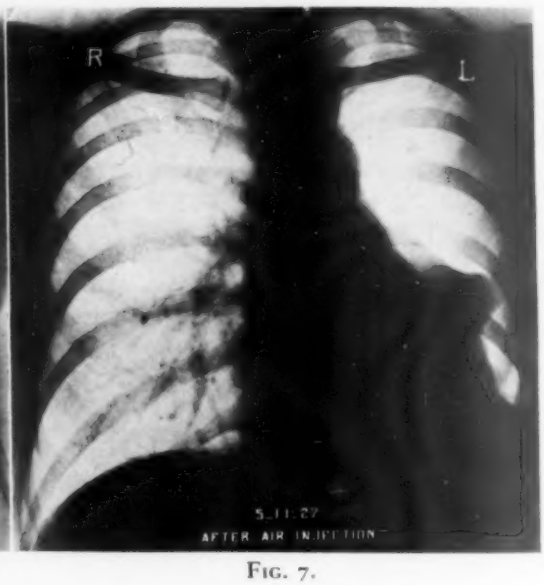

Fig. 7.

least symptomatic relief, and is especially called for in massive collapse.

(5) If bronchoscopy is contemplated, it

Fig. 8. Bronchial tumor coughed up by patient. Actual size.

is much less hazardous to institute pneumothorax first, to relieve dyspnea and allow the trachea to go back to its normal position before passing the bronchoscope.

Rigler[12] states that a few cases of postoperative massive collapse have been reported, in which alternating collapse and expanse occurred over a period of weeks, the whole course lasting several months; it is noted that no case of unilateral postoperative collapse without complication has ever proved fatal.

Mastics, Spittler and McNamee[11] report a case of postoperative massive collapse which cleared up in six or seven days, but three days later the patient went through the same symptom-complex. The second time it required much longer for the symptoms to disappear.

Physical Findings. Irrespective of the causative factors, the physical findings are constant:

(1) Retraction and immobility of the chest wall on the affected side.

(2) A high fixed diaphragm.

Fig. 9.

Fig. 10.

Recurrences. As long as the obstructing medium is present in the bronchus, collapse will recur. In our case the lung collapsed three different times, due to recurrence of the tumor in a period of sixteen months. The longest period of continuous collapse was six months.

An interesting sequel to Farris' case of postoperative massive collapse is that there was a recurrence of the collapse on the same side two months later following another operation, and complete recovery.

(3) Dullness on percussion over the atelectatic lung.

(4) Breath sounds which are tubular in approximately 50 per cent of the cases in the literature, and absent in the remaining 50 per cent.

(5) Marked cardiac displacement toward the side of the lesion.

(6) Acute displacement of the heart toward the side of the lesion.

The roentgen findings are striking: If the collapse is complete, the affected side

is opaque, the diaphragm outline is high and may be lost and the heart and mediastinal structures are displaced well into

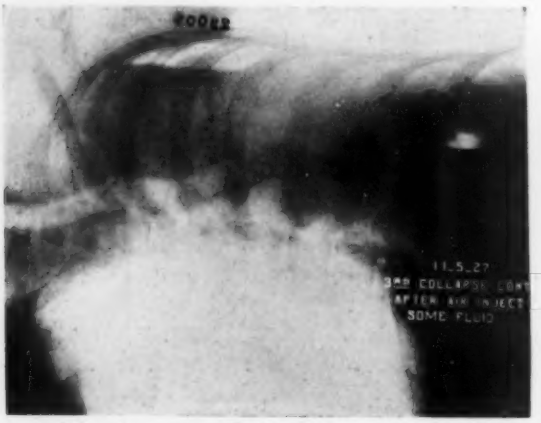

Fig. 11.

the affected side. The trachea outlined by air can be seen drawn well to the affected side.

Roentgenoscopically, the heart's impulse can barely be seen, and the diaphragm on the affected side appears fixed and may not be demonstrable. The contralateral lung is overdistended.

If the collapse is incomplete, as in the case which I am reporting, where at first the lower branch bronchus was completely shut off and the upper only partly obstructed, the collapse was complete only in the lower lobe and the upper lobe atelectatic. Where a single lower lobe is collapsed by an obstruction, which does not prevent air from entering the bronchus to the upper lobe, the upper lobe may become overdistended and force the lower collapsed lobe away from the chest wall until it occupies the cardiophrenic angle, thus compensating for the temporary increase of negative pressure.

Roentgenoscopic Observation. After the lung is partly expanded, unequal respiratory excursion of the diaphragm is shown, with "shifting of the mediastinum" from side to side, giving the motion of the heart a churning effect. During the period prior to collapse, when the bronchus is only partly obstructed, the affected side shows failure of the diaphragm to completely rise on expiration, giving the effect of obstructive emphysema, as described by Manges[10] in the roentgen finding of non-opaque foreign bodies when the air is trapped in the lung by the ball-valve

Fig. 12.

effect of the bronchial obstruction. As long as the tumor is only partly obstructive, the appearance of residual air persists, but as soon as the bronchus becomes completely obstructed, the air starts to be absorbed and the negative pressure rises gradually until the affected lung hugs the lateral chest wall, the mediastinal structures follow it over and the normal lung becomes overdistended with air. One may observe a case for the first time at any stage, and of all the signs, that of acute cardiac displacement is most characteristic.

Following the injection of air in massive collapse, the roentgenogram shows the resultant pneumothorax forcing the heart toward its normal position.

For relief of symptoms, Habliston advises injection of filtered air into the pleural cavity on the affected side to lessen the negative pressure, when it is urgent. Cyanosis and dyspnea are promptly relieved, the trachea straightens out and the heart and vessels return somewhat to their normal position. By lessening the intrapleural pressure, the obstruction in the bronchus may be released. In the case I report, injection of 600 c.c. of air reduced the pressure almost at once; several days

later the patient coughed up the obstructing tumor.

CASE REPORT*

G. C. S., white, male, aged forty. Health excellent until onset of present trouble, with the exception of a mild attack of influenza in 1917. On Jan. 1, 1927, he had a sudden attack of coughing, and believed at the time he had inhaled a portion of a nut he was eating. There was slight hemoptosis. His physician diagnosed the condition as influenza. The illness was characterized by fever, cough and dyspnea, the dyspnea being the most distressing feature. He remained in bed for three weeks and apparently recovered. He returned to work Feb. 1 in his usual good health. About March 5, while running for a train, he again had an attack of coughing, which was followed in a short time by increasing dypnea. Consultation was requested during this attack, which resulted in a diagnosis of pulmonary tuberculosis. Repeated examination of the sputum failed to show tubercle bacilli. On March 8, roentgen examination revealed an opacity in the lower half of the left chest, with some degree of cardiac displacement toward the left (Fig. 4). Roentgen diagnosis was chronic pulmonary disease, but three weeks later roentgen examination revealed a normal lung (Fig. 5). Patient returned to work in three weeks, having no difficulty until following exertion on May 4 when dyspnea and cough again occurred. At this time cyanosis appeared, and the dyspnea was greater than ever. During this attack, he was attended by Dr. F. S. Orem, who referred him to me for roentgen examination.

Stereoscopic roentgen examination of the chest revealed the heart and mediastinal structures in the left chest. The upper lobe of the left lung was atelectatic, but the lower lobe was completely collapsed; the left diaphragm was not demonstrated. The right lung was overdistended with air, and the right diaphragm moved freely (Fig. 6).

Impression: Massive collapse of the lower lobe of the left lung with atelectasis of upper lobe.

In the absence of any demonstrable cause, the history led me to suspect a bronchial obstruction, resulting from inspiration of a non-opaque foreign body or a plug in the left main bronchus.

The dyspnea and cyanosis were so severe that I advised consultation with Dr. Habliston, with the idea of injecting air into the affected pleural cavity to relieve the dyspnea.

*Case previously reported by Habliston[7].

Physical examination by Dr. Habliston: Well-developed and well-nourished man. Temperature 99.2° F., pulse 72, of good volume and

Fig. 13. Diagrammatic drawing showing the tumor in the left main bronchus, as seen from the back.

regular. Dyspnea was urgent, breathing comfortable only when sitting up. The lips, ears, and fingers were definitely cyanotic. The chest revealed a normal lung on the right side. The left chest was retracted and showed no respiratory excursion. A resonant note was found above the third rib on the left, with the remainder of the chest dull. Breath sounds were considerably diminished throughout, but over the entire lower lobe there was a distinctly tuberculous quality as evidenced by the whispered voice sound. The heart was markedly displaced toward the left, the apex being situated in the third interspace, midaxillary line, with an area of resonance between the heart and the sternum, where practically normal breath sounds were heard, being probably due to a portion of the contralateral lung which had followed the mediastinum in its shift. A needle was inserted into the left pleura and attached to an accurately calibrated mercury manometer, as former experience had shown that water instruments to be adequate, must be of unwieldy size. A marked increase in negative pressure was present, the manometer reading varying with respiration between 16 and 20 mm. of mercury equivalent to −240 to −270 mm. of water. Partial pneumothorax was induced, 600 c.c. of filtered air being introduced into the pleura, which dropped the pressure to −80 and −100 mm. of water. The disappearance of cyanosis was immediate, and dyspnea disappeared within a few minutes. Examination revealed the heart

much farther to the right, but still 3 cm. farther toward the left than normal (Fig. 7). Symptoms very gradually returned as the injected air was absorbed and two refills were done, each time reducing the negative pressure to a lower level. During the following week, a sudden attack of coughing was productive of bright red blood and the patient coughed up a cylindrical tumor mass, which he fortunately saved. The tumor measured 4 × 1.6 × 1.1 cm. and was pedunculated (Fig. 8). On pathological study, it was found to be a cellular fibroma.

Relief of symptoms was complete, the physical signs in the left chest cleared up and roentgen examination showed a practically normal lung (Fig. 9). He was bronchoscoped in the clinic of Dr. Chevalier Jackson, where the stump of tumor was located in the left main bronchus, at a point 3 cm. beyond the carina occluding about one-third of the lumen of the bronchus.

Upon his return to Baltimore, he was again bronchoscoped and the stump fulgurated. He remained well and free from symptoms until Sept. 18, 1927, when cough and dyspnea returned and collapse of the lung was again found on physical and roentgen examination (Fig. 10). This collapse lasted for five months, during which time the patient received three air injections between Sept. 20 and Nov. 7, 1927, which relieved the dyspnea and rendered him able to travel and continue to take care of his work as a traveling salesman.

Roentgen examination at this time showed complete collapse of the left lung with some air and a little fluid in the left pleural cavity (Fig. 11). The mediastinal structures were all to the left of the midline, but the patient by this time had accommodated himself to the condition and his general health was not impaired. He finally consented to return to the Jackson Clinic, Feb. 23, 1928, for further bronchoscopy. The left bronchus was again found completely occluded by the tumor.

Following this bronchoscopic examination, a roentgenoscopic study, March 5, 1928, revealed a little air in the anterior portion of the upper lobe, partially expanding the lung. The lung was, however, atelectatic and the heart and vessels were situated close to the lateral chest wall.

He was bronchoscoped at the Jackson Clinic several times between Feb. 23 and April 14, 1928, after which time, the lung was completely expanded, although the lumen of the bronchus was cut down almost one-half.

Following the last bronchoscopy, upon the advice of Dr. Clerf and Dr. Manges, roentgen therapy was instituted by crossfiring over the tumor through the chest wall, back and front. Following the first series of treatments, May 2, 1928, stereoscopic roentgen examination of the chest showed the left lung completely expanded. There was a circumscribed shadow at the left hilum (which is present in all the plates), corresponding in size with the pulmonary vein and it has never varied in size, but is at a little higher level than that of the pulmonary vessels on the right side; which Dr. Manges suspected of being a tumor enlarging the bronchus. The periphery of the lung was clear. The excursion of the diaphragm was shallow on the left side, but free on the right. There was a little residual air remaining in the left lung on expiration. The heart was slightly displaced and there was a faint shifting of the mediastinum.

Roentgen therapy was repeated on June 25, 1928, and roentgen examination showed both lungs normal; physical condition excellent. He resumed his normal activities.

CONCLUSIONS

(1) The case reported is one of recurrent massive collapse due to an intrabronchial tumor.

(2) It is remarkable because of the absence of infection, which so frequently ensues when a bronchus is obstructed for a long period of time.

(3) Three successive collapses occurred, the first lasting three weeks; the patient remained well for three months, and the lung then collapsed a second time; a month later the patient coughed up a large tumor. The lung again expanded and remained so for three months, when it collapsed a third time. This last collapse lasted six months, until the tumor was removed by bronchoscopy; the lung then expanded and is still normal.

(4) Characteristic physical and roentgen signs are explained by changes in intrapleural negative pressure.

(5) During collapse, symptoms were relieved by air injection into the affected pleural cavity to reduce the pressure.

(6) Marked displacement of the heart beyond the midline is due to increased negative intrapleural pressure and is a typical sign of collapse.

(7) The roentgen ray is one of the most important means of diagnosing this condition.

(8) Obstruction in the bronchus can easily be detected early by the roentgen appearance of obstructive emphysema.

REFERENCES

1. Blecher. Ueber die klinische Bedeutung der Bronchialekchondrosen. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1910, xxi, 837–841.
2. Caussade, G., Surmont, J., and Lacapère, J. Enchondroma of the right bronchus. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, xlix, 1299–1307.
3. Elkin, D. C. Intrapleural pressure in post-operative atelectasis. *Ann. Surg.*, 1927, lxxxvi, 885–889.
4. Farris, H. A. Atelectasis of the lung. *Canad. M. Ass. J.*, 1925, xv, 808–815.
5. Gwyn, N. B. Massive collapse of the lungs. *Internat. Clin.*, 1926, i, 136–162.
6. Hearn, W. P., and Clerf, L. H. Post-operative massive collapse of the lung. *Ann. Surg.*, 1927, lxxxv, 54–60.
7. Habliston, C. C. Intrapleural pressures in massive collapse of the lung. *Am. J. M. Sc.*, 1928, clxxvi, 830–837.
8. Holmes, George W. Massive collapse of the lung. Am. J. Roentgenol. & Rad. Therapy, 1924, xi, 509–516.
9. Kirch, E. Ueber stenosierende Bronchialgeschwülste mit konsekutiver Bronchiektasenbildung. *Centralbl. f. allg. Patb. u. path. Anat.*, 1917, xxviii, 545–569.
10. Manges, W. F. Atelectasis as a roentgen-ray sign of foreign body in the air passages. Am. J. Roentgenol. & Rad. Therapy, 1924, xi, 517–523.
11. Mastics, E. A., Spittler, F. A., and McNamee, E. P. Postoperative pulmonary atelectasis. *Arch. Surg.*, 1927, xv, 155–197.
12. Rigler, L. F. Massive collapse of the lung. *Minnesota Med.*, 1926, ix, 326–333.
13. Sante, L. R. Massive collapse of the lung. *Radiology*, 1927, viii, 1–13.
14. Sante, L. R. Massive (atelectatic) collapse of the lung. *Ann. Surg.*, 1928, lxxxviii, 161–177.

BASAL TUBERCULOSIS*

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THE purpose of this paper is to again call attention to a type of pulmonary tuberculosis which is frequently associated with tuberculous lesions elsewhere in the body. The roentgenologist, recognizing this truth, can often greatly assist the clinician by suggesting that search be made during life for such extrapulmonary lesions. In this type of case we have frequently found tuberculous lesions, often multiple, in other parts of the body during life. At autopsy these findings have been constant. The lesions suggest that at some time in the course of the disease the patient has suffered from a general infection, but this should not be construed to mean that the primary lesion was not in the lung.

In the adult apical type of tuberculosis general infection may occur, but it is quite the exception. The lesions in other parts of the body are more often small, whereas in the basal type the lesions show massive caseation or ulceration. The important practical point, clinically, is that lesions in other parts of the body should be suspected as soon as a diagnosis of basal tuberculosis is made, whereas in the adult apical type we do not expect these lesions until late in the course of the disease.

At this time we wish to add 44 cases to the 60 cases of the basal type already published.[1] As we then stated, the pathological anatomy of these basal lesions is not a finished study. The plates show two different types of lesions: tuberculous caseous bronchopneumonia and tuberculous pneumonia. The former may be so confluent as to simulate the latter. The same type of pathological condition may involve an upper lobe. Thus, in our clinic we paradoxically speak of a basal type in an upper lobe.

Two forms of pulmonary tuberculosis are clearly defined and generally understood from their names alone: miliary tuberculosis and apical fibroid tuberculosis. The former we classify as a puerile type, as we do these basal types. The latter is the adult type, and is the most common tuberculous lesion found in the adult. It generally develops in the upper lobes near the apices and is a true lobular pneumonia. These areas appear as fans on the roentgenogram. As repair takes place

[1] Dunham, K., and Norton, V. V. Basal tuberculosis. *J. Am. M. Ass.*, 1927, lxxxix, 1573–1575.

* Read at the Twenty-ninth Annual Meeting, American Roentgen Ray Society, Kansas City, Mo., Sept. 25–28, 1928.

the exudate is absorbed, scar tissue is laid down and the scar contracts; new fans develop at a later time and we have fans of different densities. The fibroid apical type, when advanced, is frequently associated with caseous bronchopneumonia at the base. This is the result of the aspiration of infectious droplets which develop caseous bronchopneumonia within the smaller air tubes and accompanying air cells.

This is not the case with the basal lesions. Sometimes they absorb; sometimes scar tissue is laid down but this is not common, and we do not expect to find lesions of different densities which indicate differing ages. We expect cavitation. Absorption is the exception, cavitation is the rule and, generally speaking, death soon follows. The usual form of tuberculous caseous bronchopneumonia is secondary to cavities formed in the old fibroid apical lesions. There is no such chance for aspiration in the basal type and these lesions must be blood borne or be the result of some massive infection through the respiratory tract.

Of these 44 cases, 40 had positive sputum. The remaining 4 were proven tuberculous by inoculation of guinea pigs.

In the former series of 60 cases, 47 (or 70.8 per cent) were in the negro. In this series of 44, admitted January 1, 1927, to July 1, 1928, thirty-eight (86.3 per cent) were in the negro.

As in our first report, we divided these cases into the pneumonic and bronchopneumonic classes. This can be only a roentgenological classification because we do not know the pathology causing these different roentgen-ray densities. It may be that they all are bronchopneumonic and those that appear as pneumonic are only pseudopneumonic. It has been noted that where a pneumonic type has undergone absorption the remaining densities have been bronchopneumonic in character. Bearing this in mind, 22 cases have been classed as pneumonic—17 in an upper lobe, 5 in a lower lobe. Twenty-two have been classed as bronchopneumonic—9 in an upper lobe, 9 in a lower lobe and 4 in which all lobes were equally involved. It must be understood that while we have stated "upper" and "lower" lobe, we mean this is the location in which pathology seems first to have appeared in the lung.

Of these 44 cases, 34 of the patients are dead, 29 dying in residence. Autopsies were performed on 17. Our pathologist has found the following extrapulmonary tuberculous lesions:

Ileocolitis	13	Tubercles in spleen	8
Mesenteric adenitis	12	Tubercles in kidney	3
Tracheobronchial adenitis	10	Tubercles in liver	3
Retroperitoneal adenitis	2	Peritonitis	4
Cervical adenitis	2	Pleuritis	4
	26	Pericarditis	1
		Salpingitis	1
		Osteomyelitis	2

We find, therefore, no reason to change the conclusions of 1927:

"Basal tuberculosis is quite common in the negro and not uncommon in white persons. One of us has spoken of it as the puerile type in the adult because it is like the disease often found in children." (It is also sometimes spoken of as "guinea pig tuberculosis.")

"The roentgen ray affords an excellent means to differentiate these types but must not be relied upon to make an etiologic diagnosis of basal tuberculosis.

"Until more is known of the pathogenesis and pathologic anatomy of these lesions it would be better to call them by their old name, 'basal tuberculosis' and include under this term the lesions simulating basal tuberculosis found in the upper lobes.

"We do know that miliary tuberculosis is generalized. We do know that the fibroid apical type is often localized. We want to know whether further studies will prove that the basal type is a part of a generalized tuberculosis, as our studies suggest."

DISCUSSION

Dr. P. R. Casellas, Chicago. I should like to ask Dr. Dunham if he has been able to establish any relation between this basal tuberculosis and the possibility of an associated luetic infection.

The reason I ask that question is because in a survey I made of 11,000 chest cases at Fort Bayard, New Mexico, I found 24 cases, a little over 2 per thousand, of basal tuberculosis. I have forgotten the exact figures, but the great

majority of them were negroes, and 96 of them gave a positive Wassermann reaction. I noticed in Dr. Dunham's paper that a great majority of the cases have some form of adenitis, and I wonder if lues can bring about a condition that will tend to limit the lesion to the base. Also in those cases that I was able to isolate they appeared to me to be unilateral, but I was never able to prove it.

Dr. S. H. Snider, Kansas City. I should like to ask Dr. Dunham to discuss further the differential diagnosis of bronchiectasis and basal tuberculosis. It has been my rule not to make any diagnosis of basal tuberculosis without a definite lesion, or unless I have positive findings of tuberculosis in the sputum, such as guinea pig inoculation.

In my experience in Kansas City, out of perhaps 10,000 examinations of chests for tuberculosis we have had 9 cases of positive sputum with all of the roentgen indications practically in the lower lobe.

I should like to have Dr. Dunham enlarge on just what percentage of cases of pulmonary tuberculosis he found apparently primary in the lower lobe. I should also like to have him discuss the use of lipiodol in basal tuberculosis.

Dr. Dunham (closing). Dr. Snider spoke of the differential diagnosis of pulmonary tuberculosis and bronchiectasis. I should like to emphasize the fact that I believe the roentgenologist has the right to inquire into the symptoms of his patients to see if his findings will explain those symptoms. Given a cough over a long time, as in bronchiectasis, given a large amount of expectoration, very likely spitting of some blood over a long period, if those lesions are due to tuberculosis you will have a definite picture on the roentgenogram. When the plate does not show the lesions which will account for those symptoms, you must stop and think. In other words, you are a consultant and unless you know all of the facts you cannot consult intelligently. It is well to give the roentgen findings without any other knowledge, that is, such as laboratory tests, but as a consultant you should take these abstract findings and in conference determine whether or not they explain the symptoms in that case. In no case will bronchiectasis reveal itself so clearly as in such a conference.

The question has arisen with regard to the injection of lipiodol into a basal lesion of tuberculosis. That reminds me of a story. Mark Twain, writing on marriage, says; "To those contemplating marriage, don't." If you are going to use lipiodol, try to exclude tuberculosis. If you have watched your case carefully and it is necessary to come to a conclusion in the treatment of that case, then use it, but use it not lightly but advisedly and discreetly. You can usually make a differential diagnosis between bronchiectasis and tuberculosis without lipiodol, but you cannot tell the extent of the lesion, nor can you find a lesion so well as with iodized oil. I think it is a great aid in diagnosis, but it should not be used in tuberculosis because fundamentally anything that disturbs tuberculosis injures the patient.

When we come to syphilis of the lung, we know nothing. Nothing is proven from the post mortem. Clinically, we all know it must exist but we have nothing on which we can stand pathologically to defend syphilis of the lung. To those men working in the Veterans' Bureau let me say, avoid a diagnosis of syphilis of the lung because you cannot prove it. Second, the mere fact that there is an abnormal lung lesion with four plus Wassermann which clears up under syphilitic treatment does not prove syphilis of the lung.

STUDIES ON ABSORPTION OF TETRAIODOPHENOLPHTHALEIN FROM THE ALIMENTARY TRACT*

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IN a recent survey of the literature on cholecystography by the oral method, we were unable to find that any studies had been conducted to determine the rôle of the stomach in the absorption of tetraiodophenolphthalein.

It was formerly assumed in the absence of definite proof that many substances were absorbed from the gastric mucosa, but experimental evidence has since indicated otherwise, most workers agreeing that no appreciable absorption takes place in the stomach.

Water is poorly absorbed. Von Mering has shown that it begins to pass into the intestine almost immediately after it is swallowed and he was able to collect 495 of 500 c.c. within twenty-five minutes in a large dog with a fistula in the duodenum.

Sugars and peptones are not absorbed unless given in concentrated solutions and the same holds true of salts and certain drugs. On the other hand, alcohol is readily and rapidly absorbed in the stomach.

Because of the abundance of work performed on the oral administration of tetraiodophenolphthalein for gall-bladder visualization, it occurred to us that it would be of interest to determine, if possible, whether or not any absorption of the dye takes place in the stomach.

FIG. 1. Gall-bladder shadow sixteen hours after introduction of 8 gm. of dye into the duodenum. Pouch dog, weight 48 lb.

FIG. 2. Gall-bladder shadow nineteen hours after introduction of 8 gm. of dye into the duodenum. Pouch dog, weight 48 lb.

Accordingly experiments were undertaken as follows:

1. Pavlov pouch dog, weight 48 lb. This animal had been operated on by Dr. A. C. Ivy in 1926 and a pouch made of the entire stomach. The general condition of the dog was excellent and our work was greatly facilitated by its splendid co-operation.

On May 19, 1928, three grams of tetraiodophenolphthalein in 60 c.c. of water was introduced directly into the pouch and the first roentgenograms made

* Read at the Twenty-ninth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Kansas City, Mo., Sept. 25–28, 1928.

seven hours later. No shadows of the gall-bladder were obtained. Subsequent exposures were made at the seventeenth, the gall-bladder were secured at the sixteenth and nineteenth hours. Death occurred at the twenty-eighth hour due

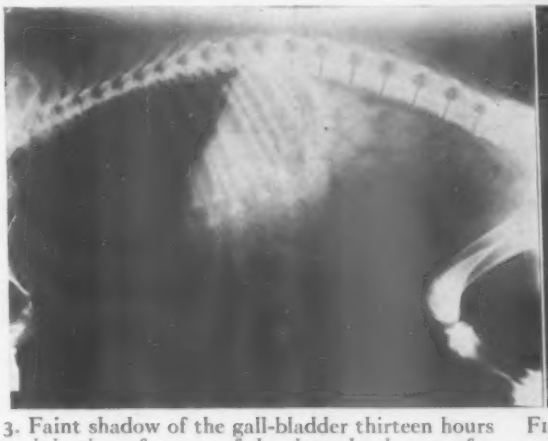

FIG. 3. Faint shadow of the gall-bladder thirteen hours after injection of 3 gm. of dye into duodenum of a dog (weight, 18 lb.) with pylorus divided.

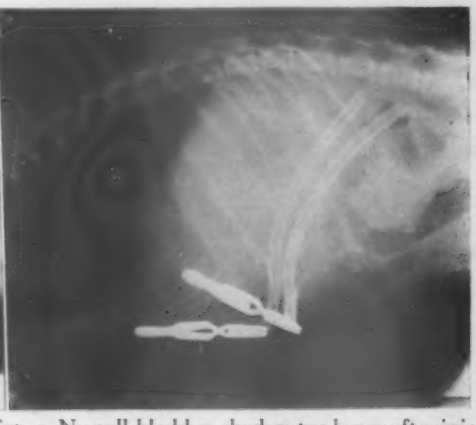

FIG. 4. No gall-bladder shadow ten hours after injection of 3 gm. of dye into stomach of a dog (weight, 18 lb.) with pylorus divided.

forty-eighth and fifty-third hours with no resultant shadows. The animal experienced no reaction at any time.

2. On May 26, 1928, a similar solution of the dye was introduced into the duodenum by means of a stomach tube. A mild diarrhea ensued at the end of thirty minutes. Roentgenograms were taken at the same time intervals as when the dye was placed directly in the pouch. In no instance did visualization of the gall-bladder occur.

3. On June 14, 1928, eight grams of tetraiodophenolphthalein in 60 c.c. of water was introduced directly into the pouch. The instillation of this large dose produced a copious flow of mucus almost immediately after, and at the end of fifteen minutes vomiting occurred and persisted for five minutes. Undoubtedly the irritation set up in the pouch produced reverse peristalsis in the duodenum. Films were made at the fourth, tenth, twenty-fourth, thirty-sixth and forty-eighth hours. No gall-bladder shadows were obtained.

4. On June 21, 1928, eight grams of tetraiodophenolphthalein in 60 c.c. of water was introduced into the duodenum by means of the stomach tube. The dog vomited within five minutes and a small amount of the solution was expelled. A very severe diarrhea manifested itself within half an hour. Excellent shadows of

to the severity of the diarrhea. An autopsy performed by Dr. Benjamin Roman, pathologist to the Buffalo General Hospital, revealed only a marked enterocolitis.

FIG. 5. No shadow of gall-bladder twenty-four hours after introduction of 8 gm. of dye directly into the pouch of a dog.

It was rather surprising that no visualization of the gall-bladder occurred after 3 grams of the dye had been introduced into the duodenum. Dr. Lester Whitaker in a personal communication stated that, when given orally, very large doses of the dye were necessary to produce shadows in dogs. We therefore substituted a larger

quantity, namely, 8 grams, which produced the desired shadows.

When this concentrated dye solution was placed in the pouch, the animal became nauseated and vomited but otherwise suffered no untoward symptoms. An identical amount in the duodenum resulted in death.

5. On June 24, 1928, a dog weighing 18 lb. was used. Under ether anesthesia the pylorus was divided and a small rubber catheter inserted for a distance of one-half inch and invaginated. A similar catheter was invaginated in the duodenum. These were brought through the abdominal incision. Three grams of dye in 30 c.c. of water was injected by means of a syringe through the tube into the stomach. The animal died nine hours after the operation. Roentgenograms after death did not reveal gall-bladder shadows.

6. On June 27, 1928, a dog weighing 18 lb. was used. The operative procedure was the same as in the preceding experiment, except that the dye in this instance was injected through the rubber tube into the duodenum. Death occurred at the twelfth hour following the operation and on the cholecystogram a faint shadow was discernible.

Interference with the circulation because of the ligation of the blood vessels and lymphatics at the pylorus may have detracted from the value of these two experiments, but considering that the results were similar to those obtained in the pouch dog they may be regarded as confirmatory evidence that little if any dye is absorbed in the stomach.

CONCLUSIONS

1. The amount of tetraiodophenolphthalein that may be absorbed from the stomach is insufficient to produce gall-bladder shadows.

2. When given orally to dogs very large doses are necessary to secure cholecystograms.

3. Three grams of the dye introduced directly into the duodenum of the dog induced a mild diarrhea. No type of reaction followed a similar amount in the pouch.

4. Eight grams in the pouch caused reflex vomiting over a short period of time. Roentgenograms revealed no shadows. The same amount in the small intestine visualized the gall-bladder but induced a reaction which resulted in death.*

* We are indebted to Dr. Edward Koch of the University of Buffalo for his co-operation and to Dr. A. C. Ivy who furnished the "pouch" dog; also, to Dr. Leon J. Leahy and Dr. Milton Kahn who performed the operations on the other animals.

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EARLY DIAGNOSIS OF PERFORATED PEPTIC ULCER*

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THE importance of early diagnosis of acute perforated peptic ulcer is well recognized. Such a condition demands immediate surgical treatment as the prognosis depends largely on the time which has elapsed since its onset. The importance of the time element is shown by a series of 25 cases reported by McCreery. He noted a mortality of 60 per cent in those operated on between twelve and twenty-four hours and a mortality of 100 per cent where operation was delayed over forty-eight hours.

The case here reported is one in which free intraperitoneal air was demonstrated within ten minutes after the acute perforation occurred.

The patient, W. E. D., male, white, aged thirty-seven, is a lunch room proprietor. There is nothing in the family history or previous personal history of importance except that in the past he would eat his meals at irregular hours and that there was a tendency to bolt his food.

The history of his present illness is as follows: He came to our office on the morning of December 16, 1926, for examination and just as his history was about to be taken he was suddenly seized with agonizing pain in his abdomen which doubled him up. He was quickly assisted to an examining table where a hasty conference was held. He managed to state that there had been no history of indigestion except for the past ten days, since which time he had suffered from acid stomach, heartburn, and bloating. These symptoms would occur at regular intervals about two hours after meals and would be promptly relieved by food.

On examination there was observed a moderate degree of shock. Breathing was relatively easy and of the costal type. The abdomen was definitely rigid but the most pronounced muscle spasm was noted in the upper half. There was generalized tenderness which was more marked in the upper epigastrium and right hypochondrium. Within ten minutes after the onset of these acute symptoms, he was placed on the roentgenoscopic table and the following observations were made:

Roentgenoscopic examination of the chest showed almost complete fixation and medial flattening of the right diaphragm. The left diaphragm moved only very slightly on breathing. On coughing the diaphragm did not move. Just below each diaphragm there was noted a small amount of air which seemed located between the dome of the liver and the undersurface of the diaphragm. Figure 1 shows the presence of free air between the dome of the liver and the undersurface of the diaphragm and between the diaphragm and abdominal viscera on the left side.

Other findings were as follows: Temperature, 97.2°; pulse, 74; respiration, 32, regular. Two leucocyte counts were made, the first showing 8,500 white blood cells and the second, approximately two hours later, 12,000. The patient was at once transferred to Emergency Hospital where an immediate operation was performed.

The operative findings were as follows: Upon opening the peritoneum a thick, yellow, fluid escaped, having an odor of gastric juice. There was a large quantity of fluid between the diaphragm and the liver. There was a perforated ulcer at the pylorus about 0.5 cm. in diameter from which the gastric contents were escaping. The ulcer was inverted and closed over with omentum, and a posterior gastroenterostomy was done on account of the narrowing of the lumen of the pylorus. The abdomen was then closed without drainage.

Comment. A recent survey by Meyer and Brams who tabulated 62 cases of acute perforation of gastric and duodenal ulcers shows that without exception all of the cases occurred in males. The greater incidence of ulcer in men as compared with women does not fully explain this feature, as most observers do not place the preponderance of ulcer in males much more than three or four times as great as in women. From the standpoint of diagnosis this observation is naturally of great importance. In our clinic there is no record of acute perforation of gastric ulcer in a female.

Another interesting point is the age at which perforation occurs, the majority being between the ages of thirty and forty. This observation is of value in the differ-

* Read before the Medical Section of the Medical Society of the District of Columbia, Nov. 23, 1928.

ential diagnosis from acute appendicitis, which occurs with much greater frequency in younger adults.

Regarding the past history, Gibson reports a series of cases, 25 per cent of which did not give a history of digestive disturbances before the perforation occurred.

Fig. 1. Shows the presence of free air between the dome of the liver and the under surface of the diaphragm and between the diaphragm and abdominal viscera on the left side.

Another question that has been quite perplexing is the relation of perforation to the distention of the stomach with food. The case here reported had been fasting about fifteen hours prior to his admission to our office, showing that distention with food alone probably plays a comparatively minor rôle. In this case there was no history of physical strain or unusual exertion.

From a review of the literature the problem of differential diagnosis in these cases seems a difficult one. Acute perforating ulcer of the stomach or duodenum is at times confused with intestinal obstruction, acute pancreatitis and occasionally cholecystitis with cholelithiasis. However, in none of these cases is the board-like rigidity of the abdomen so pronounced as in perforated ulcer. Acute appendicitis probably offers the most difficult point in differential diagnosis. As W. J. Mayo has pointed out, the infective material from dùodenal perforation tends to gravitate to the right lower quadrant, and the resulting peritonitis is frequently referred to as appendix disease. It is interesting to find that of 51 cases of acute perforation of the stomach and duodenum reported by Mohnin, 19 were operated upon for acute appendicitis.

This brings us to the relative merit of air free in the peritoneal cavity as an aid in early diagnosis of perforation of the gastrointestinal tract. In every case of perforation of the stomach or duodenum free gas and fluid are present in the peritoneal cavity. The gas may pass between the liver and the diaphragm as shown by Figure 1 and thus cause obliteration of the liver dullness. Little dependence can be placed on liver percussion as ordinarily practised because of the very great variations both in health and disease. Intra-abdominal air is not limited to ruptured peptic ulcer but may occur after perforation anywhere in the gastrointestinal tract. However, such latter conditions are rather rare and do not detract substantially from its value in perforated peptic ulcer. The sign when found, is practically pathog-

nomonic of perforation. While other equally valuable diagnostic criteria should not be disregarded this sign is, however, of more value in early diagnosis than the usually unsuccessful search for diminished liver dullness. The search for this sign should not require more than five minutes, since the patient can be placed before the roentgenoscope while still on the hospital carriage and no special preparation or contrast meal is necessary.

It is surprising to note in the literature the relatively few cases of gastric or duodenal ulcer in which this sign was used. Vaughan reported 13 cases and there were 12 to 16 scattered observations. In all of these, many hours elapsed before the patient was roentgenoscoped and even in Vaughan's large series the earliest observation he made was two hours after the supposed accident. We feel justly fortunate in having observed this sign within ten minutes after the perforation and it is believed that this is the earliest that the sign has been demonstrated.

A CASE FOR DIAGNOSIS

BY M. C. SOSMAN, M.D.

BOSTON, MASSACHUSETTS

S. F., male, aged thirty-three, admitted to the Peter Bent Brigham Hospital, August 10, 1928. Complaint—pain and swelling upper third of the right leg.

Family and past history are unimportant.

His best weight is 150 lb.; average 138; present 130.

Present Illness. For one year this patient has noticed a slight recurrent pain in the upper part of the right leg. The onset was indefinite, and there was no trauma. The pain was not severe or incapacitating, and he thought very little of it, although slight tenderness was present. For the past month the pain has been more frequent. Six days before admission, while walking out of the water after a swim, the right leg "gave way," and he found he could not move his leg without pain, nor would it bear his weight. Immediate swelling and discoloration appeared just below the knee. He was carried home to bed, and ice was applied, with no relief. He was brought to this hospital where a roentgen examination (Fig. 1) showed an indistinct, oval area of decreased bone density in the upper end of the tibia, roughly 10 cm. in length, 3 cm. in depth, and 3.5 cm. in width, just below the tibial tubercle. Through the lower portion of this area there was a complete transverse fracture with some protuberance on the anteromedial aspect. The condition was diagnosed as a pathological fracture through an area of rarefying osteitis, cause unknown, but thought to be benign because of the apparent expansion of the cortex. The patient was admitted to the hospital.

Physical examination showed a well-developed and nourished young man with slight irregularity of the pupils but normal reaction to light and accommodation. General examination was otherwise negative. Local examination showed the upper end of the right leg to be swollen, tense, and discolored by hemorrhage, not very painful or tender. There was no obvious deformity, and no crepitus. Temperature was normal. Urine and blood examinations, including Wassermann and Hinton, showed nothing abnormal.

A plaster cast was applied and the patient discharged.

Re-examination by roentgen ray six weeks later showed fairly marked callus formation with a slight spread of the rarefied area.

The patient was re-admitted December 10 because of a recurrence of pain during the past three weeks.

Third examination by roentgen ray at this time showed a marked increase in the absorptive process in the upper end of the tibia, especially marked just below the condyles where there seemed to be a second pathological fracture (Fig. 2). Films of skull, spine, chest and long bones showed nothing abnormal.

Physical examination at this time showed abnormal mobility of the upper end of the tibia, and a small protrusion on the medial aspect just below the condyle.

Biopsy was done through a thickened periosteum which was adherent to the bone. The latter was soft and spongy, and a section was removed with a scalpel, and some of the deeper tissue removed by gouge.

Grossly the tissue appeared cartilaginous in type, apparently with fibrous tissue mixed up in it, and the second portion appeared to be of bone and fibrous tissue mixed. It did not suggest malignancy in gross appearance.

Histologically, the tissue shows regular but atypical newly formed bone trabeculae (Fig. 5) separated by various types of soft tissue ranging from firm, somewhat acellular fibrous tissue to exceedingly cellular connective tissue,

FIG. 1. Note area of expansion at the point of fracture on the medial edge of the tibia suggesting a central expanding lesion. The lateral view shows, however, that the process is mainly in the anterior half of the bone.

FIG. 2. Showing second pathological fracture and a marked increase in the absorptive process.

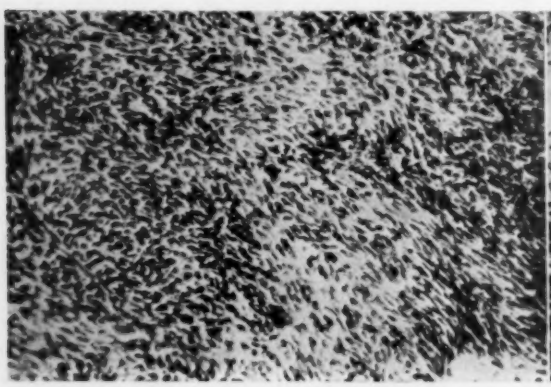

FIG. 3. Histological section (× 300) through the very cellular part of the material. Numerous mitotic figures are present.

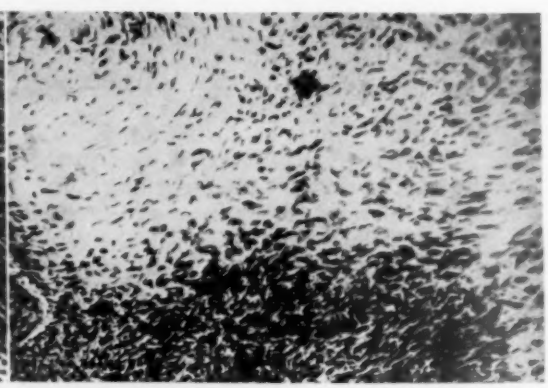

FIG. 4. Histological section (× 300) showing a dense fibrous tissue, apparently cicatrization of the cellular process.

with spindle-shaped cells and numerous mitotic figures (Fig. 3). In some places there is considerable collagen, in others none. There are many cells with large, lobated nuclei, and there are a few foreign body giant cells present. Other portions of the section show a process which is apparently cicatrization of the various cellular areas amounting practically to dense fibrous tissue (Fig. 4) suggesting the structure of fascia seen in cross section. There are also small areas of degeneration and necrosis. There is no normal bone seen in any part of the sections, nor does it have the appearance of normal callus because of the lack of normal osteoblasts at the periphery of the osteoid trabeculae. Therefore, while many fields are indistinguishable from those found in osteogenic sarcomas, the process, as a whole, prevents this diagnosis being made inasmuch as the end result of the rapid growth seems to be cicatrization. The process can, therefore, be likened to a tremendously accelerated, progressive, destructive osteitis, with accompanying proliferation of osteoid tissue.

Dr. Mallory studied the films and sections and decided that the disease was not a tumor. He could offer no other diagnosis except chronic inflammation, which apparently includes everything not neoplastic.

Dr. E. A. Codman saw the sections and roentgenograms, and pronounced it a perfectly typical osteogenic sarcoma.

Dr. James Ewing, of New York, classed the process as definitely neoplastic, of the low-grade spindle-cell osteogenic sarcoma type. He did not think it was very malignant or capable in this form of producing metastases, but he said that he had seen similar cases with progressive recurrences and increased activity after operations. He noted giant cells of the benign foreign body type, new growth of normal bone, and an area of necrosis which suggested simple inflammatory reaction, but concluded that the tissue was altogether too cellular to be classed as benign. He advised repeated roentgen treatments.

Dr. S. B. Wolbach, of Boston, described the process as "a destructive, proliferative osteitis," and noted that it was similar to Paget's disease.

The patient was given two deep roentgen

Fig. 5. Histological section (× 300) showing the soft, atypical osteoid tissue, cicatricial tissue and, on the margin, the cellular areas called by Ewing sarcomatous.

treatments, Jan. 8, 1929, and Jan. 9, 1929. Re-examination six weeks later showed no apparent effect, either beneficial or deleterious.

Comment. This is a fairly typical example of what happens frequently, more particularly since the establishment of the Registry of Bone Sarcoma by Dr. E. A. Codman. In the attempt to make an early diagnosis of sarcoma, specimens from biopsy are frequently submitted to various pathologists, with a marked variation in the reports. It is frequently impossible to decide what is the best thing to do when such a patient first presents himself, and even a biopsy may leave us in a state of indecision. This patient is at present under observation receiving roentgen treatments with amputation as a possible recourse in case the process continues to spread. If the diagnosis becomes more certain, a follow-up on this case will be presented later.

A CASE OF GIANT CELL TUMOR OF THE TARSAL SCAPHOID

BY P. F. BUTLER, M.D.

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BOSTON, MASSACHUSETTS

A WOMAN, aged thirty, had been complaining of pain in her foot for six or eight months. Roentgen examination (Fig. 1) showed a honey-combed, trabeculated, thin area, involving most of the tarsal scaphoid, but leaving the outline intact. This was diagnosed as a giant cell tumor.

FIG. 1. Giant cell tumor of tarsal scaphoid.

Operative removal of the entire scaphoid was followed by complete relief of symptoms. The pathological report by Dr. Mallory was "chronic inflammation with foreign-body giant cells, so-called giant cell tumor."

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FOREIGN BODY IN THE BRONCHUS

BY RICHARD DRESSER, M.D.

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BOSTON, MASSACHUSETTS

(CASE No. 164218.) Female, aged thirty-five. This patient had seven teeth extracted under gas and ether anesthesia. She slept poorly that night and the next day complained of general weakness and a feeling of muscle soreness. She began to cough and her temperature became elevated to 101° to 102°. The fever continued. The cough was not productive. There was no pain in the chest.

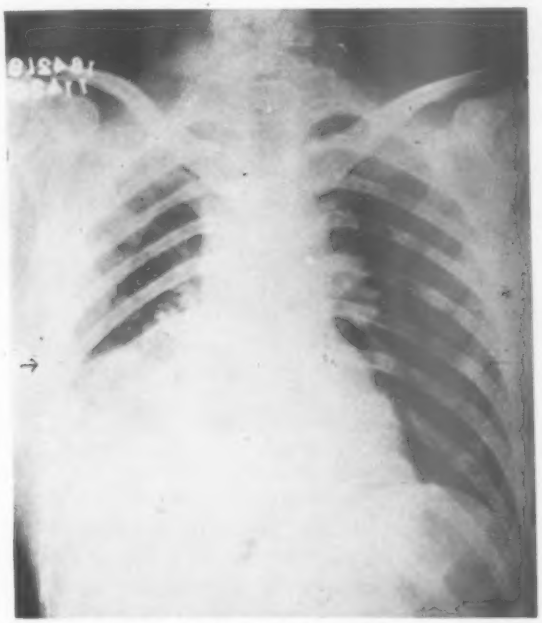

FIG. 1. Collapse of the right lower lobe as a result of obstruction of the bronchus by a foreign body. Elevation of the right diaphragm, with slight displacement of the mediastinum.

Six days after the extraction, a roentgen examination of the chest was made (Fig. 1). The left diaphragm was normal in position and excursion. The left lung field was clear. The right diaphragm was much higher than normal, and strangely enough there was very little if any limitation of the respiratory motion of the right diaphragm. The lung field above the diaphragm was clear. There was only slight displacement of the mediastinal shadow towards the right; there was no narrowing of the interspaces. These findings together with the history indicated collapse of the right lower lobe.

A bronchoscopy was performed the following day, disclosing a foreign body in the right descending bronchus which was removed without difficulty. This proved to be a ball of cotton with a small piece of bone attached to it. Following the removal of the foreign body, the temperature became normal and the patient's general condition improved rapidly. A second examination of the chest (Fig. 2) showed the diaphragm in its normal position. There was slightly decreased radiability at the right base.

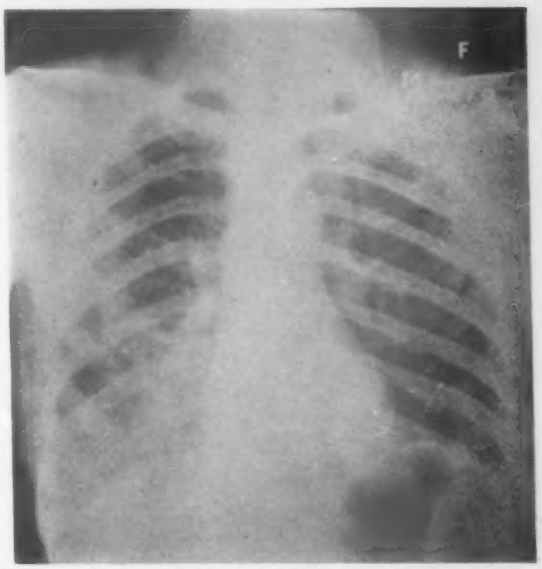

FIG. 2. Foreign body removed. The diaphragm has returned to its normal position.

This is a proved case of collapse of the lower lobe following obstruction of the bronchus by a foreign body. It is interesting to note that although the right diaphragm was unusually high in position its respiratory movement was not limited. There was very little displacement of the mediastinal shadow, and no appreciable narrowing of the interspaces, a picture rather different from that seen in massive collapse of the lung without demonstrable obstruction of a bronchus.

A CASE OF FECALITH

BY RICHARD DRESSER, M.D.

Massachusetts General Hospital

BOSTON, MASSACHUSETTS

(CASE No. 164256.) Male, aged twenty-seven.

Chief Complaint. Constipation.

FIG. 1. Filling defect in much dilated rectum.

Present Illness. The patient states that he has been constipated all his life and has always taken cathartics frequently. If he does not have regular bowel movements he has pain in his lower abdomen. He has lost a slight amount of weight. The constipation is somewhat intermittent. Sometimes he goes for a week with fairly normal movements, and then goes for a week with no movements at all. He has passed no blood. The remainder of the history is essentially negative.

The physical examination is negative except for the abdomen, where a mass the size of a grapefruit can be felt in the suprapubic region. This mass is at times freely movable, while at other times it is non-movable. Digital examination reveals no mass in the rectum. No proctoscopic examination made.

Cystoscopic examination shows a large mass extending into the bladder cavity. It is smooth and covered with mucous membrane. The entire right side of the bladder is involved. No pedicle seen. Bimanual examination shows the mass apparently to involve the bladder. Impression, solid tumor of the bladder wall.

Examination of the colon by barium enema.

FIG. 2. Dense, tumor-like mass in the pelvis. Film taken eleven days after barium enema.

The rectum fills readily, and is enormously dilated. It shows a large smooth filling defect which is thought to be outside the lumen. This corresponds to a palpable mass which is freely movable. The sigmoid is long and on the left side. The remainder of the colon is incompletely filled due to gas and fecal material. Conclusions: It is thought that the mass is outside the colon pressing on the rectum and causing dilatation (Fig. 1).

Cystogram—The shadow of the injected bladder is fused with the barium-filled bowel. The examination is unsatisfactory.

The examination of the gastrointestinal tract by barium meal is negative.

A plain film of the pelvis taken eleven days after the barium enema (Fig. 2) shows a round, dense, mass about 8 cm. in diameter in the region of the rectum. After a review of all the examinations it is believed that the mass is cystic and that it lies between the rectum and the bladder. The density of its shadow may be due to retained barium, but it is more probably due to calcified material in the tumor itself.

Exploratory laparotomy was performed. The rectum and the sigmoid were found to be greatly dilated. In the lumen of the rectum could be felt a large smooth mass which was a fecalith. This was broken up manually and extracted.

This case illustrates the necessity of a complete examination. If a plain film of the abdomen had been taken before the barium enema was given, or if the patient had been proctoscoped, a correct diagnosis would have been arrived at.

RADIUM IN THE TREATMENT OF MULTILOCULAR LYMPH CYSTS OF THE NECK IN CHILDREN*

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ROCHESTER, MINNESOTA

THE treatment of multilocular lymph cysts, or cystic hygromas, of the neck has in the past been considered surgical. The indiscriminate use of the term "hygroma colli" makes it difficult to evaluate some of the reports in the literature of the surgical removal of cysts of the neck, since the term has been used to designate not only true multilocular lymph cysts, but other types of tumors.

Thirteen cases of cystic hygromas of the neck in infants and children have been seen in The Mayo Clinic during the last ten years (1918 to 1927 inclusive). Because of the extent of the tumor, excision was considered advisable in only one case. Radium was used in the remaining twelve. In New's report of one of the cases in this group is the only reference I have been able to find in the literature to radium treatment in these cases.

The etiology of multilocular lymph cysts is obscure, in spite of the various hypotheses advanced. Among the possible causes, the following have been suggested: cystic development of the connective tissue, endothelial cysts arising from lymph vessels, or in connection with the carotid ganglion or the thyroid gland. Dowd's hypothesis seems the most plausible. He believes a regional disturbance in development causing abundant formation and prolonged growth of lymph vessels with subsequent lack of or insufficient communication with the remaining lymph vessel system to be responsible. In support of this view he points out that both Huntington and McClure have shown that the lymphatics in the cervical region of mammals develop as independent structures which secondarily connect with the veins, and failure of these independent structures to join the veins properly might well give rise to the development of cysts.

Hygromas arise beneath the deep cervical fascia but may extend into the subcutaneous tissue. They may be either unilocular or multilocular. Grossly the latter, which alone are considered here, consist of a mass of thin-walled cysts of varying size filled with serous fluid. The larger cystic cavities do not, as a rule, communicate directly with one another. It has been observed repeatedly on draining infected cystic hygromas that some of the cavities are filled with pus, and that others contain only turbid or even clear fluid. The smaller cysts, however, communicate with each other freely and they may form an indirect communication between some of the larger cysts. Such a communication might readily be occluded by edema early in the course of an inflammatory process. The fibrous walls of the cyst are extremely vascular, usually smooth and are lined with endothelium.

Hygromas are not infrequently associated with true lymphangiomas. The relationship between them may in fact be merely one of degree of dilatation of the lymph vessels. Firm nodules are often found interspersed between the cysts of an extensive hygroma, and microscopic examination of these shows the characteristic structure of lymphangioma. In cases in which the tumor bulges into the floor of the mouth an associated lymphangioma of the tongue with macroglossia

* Read at the Thirteenth Annual Meeting, American Radium Society, Minneapolis, Minn., June 11–12, 1928.

of varying degree is often present (Figs. 1 and 2).

True cystic hygromas of the neck are rare. They are usually soft, semifluctuant, freely movable tumors on the side of the neck, in some cases extending onto the face, or into the axilla. They are sometimes pedunculated. The overlying skin is usually normal in appearance, although it may be tense or stretched, due to the large size, superficial location, or weight of the tumor. The mass may be as translucent as hydrocele of the testis.

Fig. 1. Large cystic hygroma with associated lymphangioma of tongue.

Fig. 2. Cystic hygroma; bulging of floor of mouth and macroglossia are shown.

Most of the patients with tumors of this type are infants and young children. Bland-Sutton ascribes this to the tendency of hygromas to disappear spontaneously, especially following acute inflammation of the growth. He also mentions that the mass may sometimes disappear after traumatic rupture. Although the tumors are congenital, they may escape notice for several weeks or even for a month or two after birth. This is readily explained by the fact that the tumors are extremely soft and often occur at the base of the neck where slight fullness might well be overlooked. Winslow reported a case in which the tumor was first noticed following trauma when the child was about two years old. Borst stated that the tumors usually occur in the submaxillary region. None of the tumors in the series reported here, however, was localized to this area alone. In Dowd's review of all of the cases of hygroma reported up to 1913, the neck was the principal site of involvement in 91 cases, the axilla in 35; eleven occurred elsewhere in the body. In all of the cases in my series the growth was primarily in the neck. There was extension into the supraclavicular region in 7 cases, the parotid in 6, the mastoid in 4 and the temporal region in 2; the mass bulged the floor of the mouth in 3. In one case there was bulging of the lateral wall of the pharynx.

The size of the tumors varies greatly. Often they are quite small at birth, although they may be large enough to interfere with delivery. They are, as a rule, unilateral but may be bilateral and almost completely envelope the neck. Some of the unilateral growths may be very extensive, forming a continuous mass from the temporal region to the clavicle (Fig. 3). The thoracic cavity may also be involved. Four cases in this group of 13 showed evidence in the roentgenogram of extension into the mediastinum. In one of these the tumor extended from high in the right parotid region down over the side of the neck and deep into the thorax. The

visible portion of the mass measured about 10 by 10 by 20 cm.; the intrathoracic portion, shown in the roentgenogram, was approximately half this size.

The rate of growth of these cystic tumors is extremely variable. Usually

Fig. 3. Diffuse cystic hygroma extending from temporal region to base of neck.

there is a slow gradual enlargement which keeps pace with the growth of the child, unless, as frequently happens, the tumor becomes acutely infected. The size of the hygroma at birth usually bears little relation to the size at the time of examination even in young children, although the parents of 2 of the patients examined in the clinic stated that the tumor had changed very little since birth. In one case, that of a child aged fourteen months, the growth had increased from a small, flattened tumor first noticed at the age of two weeks to an extensive cystic mass covering a large part of one side of the neck and the lower part of the cheek. In another case it had grown from about 6 cm. in diameter at birth to a pendulous mass which was about 10 cm. in diameter.

As a rule the benign, soft, freely movable, painless mass in the neck does not produce symptoms, although it is unsightly. Because of its intimate relation to the trachea, varying degrees of dyspnea may be present, especially when the patient turns his head. A patient with extensive intrathoracic involvement was slightly dyspneic whenever the pendulous mass in the neck was placed under torsion. Slight dysphagia was present in some of the cases in which the tumor elevated the

Fig. 4. Same patient as that shown in Figure 2. Infected cystic hygroma.

floor of the mouth. Acute inflammation is prone to occur in the tumors; the clinical picture then changes from that of an almost symptomless tumor to one extremely alarming and serious (Fig. 4). During such an acute process the tumor enlarges rapidly. Recession of this enlargement, on the other hand, is a slow, gradual procedure requiring weeks. The soft, flabby mass promptly becomes markedly enlarged, tense, indurated and painful, and the overlying skin is involved in the acute inflammatory process. Owing to the extreme vascularity of the tumor, absorption is rapid and toxic symptoms are acute. One of the more common and serious complications is the severe dyspnea due to the increased pressure on the trachea. Dysphagia also may be pronounced. The acute process is sometimes associated with an acute head cold or sore throat. It may be due to trauma or it may come on insidiously. It frequently ends fatally because of the toxemia and exhaustion or possibly because of respiratory obstruction, since the huge infected mass overlying the trachea precludes tracheotomy. On account of the early reddening and induration of the overlying skin, drainage is

frequently instituted early, to the decided detriment of the patient, since the infectious process may at this time be localized to only a few of the cystic cavities and on breaking down the intervening cyst walls rapid extension follows. The mortality associated with these acute infections in children is extremely high, and this rather than spontaneous regression of the tumor probably accounts for its rarity in adults. I have not observed a case in which the growth disappeared spontaneously following an acute inflammatory process; acute infection of the mass resulted fatally in 7 of the series of 13 cases.

Fig. 5. Cystic hygroma before radium treatment.

Fig. 6. Same patient as that shown in Figure 5, after radium treatment.

A positive clinical diagnosis is as a rule readily established, being based on the history and examination. The history of a slow-growing mass situated laterally in the neck with or without extension onto the face, that has been present since birth or shortly following birth, usually with frequent acute inflammatory exacerbations, is characteristic. The clinical appearance of the soft, rather poorly circumscribed, fluctuant, noncompressible tumor over which the skin can be moved readily, with at times scattered areas of firm consistence, is seen only in this group of tumors. Moreover, the clinical picture presented by the other types of congenital cysts of the neck is sufficiently characteristic to permit differentiation. Cysts of the thyroglossal duct invariably occur primarily in the anterior median line of the neck, most commonly in the upper half and are usually associated with a palpable subcutaneous cord attaching the cyst to the hyoid bone, so that it is elevated during the act of swallowing. These cysts are usually comparatively small, not more than 2.5 or 3 cm. in diameter, and as a rule they are tense. If they have ruptured or have been drained at any time, the thick, mucinous, egg-white appearance of the discharge will usually have been observed by the patient or his relatives.

Branchial or pharyngeal cysts developing from remnants of the branchial clefts often occupy the same position as multilocular lymph cysts. They are always unilocular, well circumscribed, and as a rule more tense than the latter. At times the cutaneous termination of other branchial sinuses will be apparent, and occasionally subcutaneous cartilaginous nodules are associated. These cysts also are usually smaller than the cystic hygromas in children. Dermoid cysts may occur in the submental area and bulge the floor of the mouth. Occasionally large cysts extend into the submaxillary regions. They usually have a distinctly doughy consistence on palpation and there is

little likelihood of confusing them with the hygromas. Lipomas may be difficult to differentiate, although their firmer consistence, lack of translucence and less diffuse outline will as a rule distinguish them. Unlike the angiomas, the hygromas are common. In the cases in which the tumors are more extensive, especially those in which there is mediastinal involvement, excision is not feasible. A conservative operation often accomplishes little, and aspiration even less. Since 1918 radium

Fig. 7. Cystic hygroma before radium treatment.

Fig. 8. Same patient as that shown in Figure 7, after radium treatment.

are not compressible. The appearance and consistence of the two, however, is often strikingly similar, and this is greatly accentuated in cases in which there is extension of the hygroma into the mediastinum, since the mass becomes more tense and more prominent on coughing or with any straining effort.

Practically all reports appearing in the literature on the treatment of these cystic tumors advocate surgical measures. Excision has been most widely practised, and if the tumor is fairly well localized the procedure is satisfactory, although recurrence may follow the surgical removal of even this type of growth. In a few reports repeated aspiration of the cysts, followed in some cases by the injection of iodine or excision of the mass has been advised. In The Mayo Clinic all multilocular lymph cysts of the neck observed prior to 1918 were treated surgically, but the results were rather unsatisfactory. The extent of the operation and the youth of the patients involve considerable risk, and recurrences has been used almost exclusively in The Mayo Clinic in the treatment of these tumors in children. The application does not cause pain, and with persistent careful treatment the tumor can be reduced in size or even made to disappear without scarring the overlying skin. Moreover, radium treatment, in contradistinction to surgical procedures, does not carry mortality with it. The principal disadvantage of irradiation is the necessity of repeating it at intervals of from two to three months over a long period, during which a fatal acute infection may develop in the mass. The treatment, however, apparently does not increase this possibility.

Of the 13 patients in this series only 2 were aged more than three years; the oldest was thirteen years and the youngest four and a half weeks. Four of the patients were boys and 9 were girls. The tumor was situated on the right side of the neck in 5 cases, on the left in 5, and involved both sides in 3.

In 12 of the 13 cases radium was used as a part of the treatment. In the Clinic, the radium was administered directly over the tumor at a distance of 2.5 cm., with screening of 2 mm. of lead. Topical applications only were made; from 3000 to 7000 mg-hr. of radium were administered at each treatment, and the application repeated at intervals of from two to three months. If the growth was acutely inflamed the applications were less intensive. Each patient was given from one to nine treatments; the average was about four. Since some of the patients received radium treatment elsewhere subsequently, these figures are only approximate. Three of the patients thus treated are now entirely well (Figs. 5 and 6). The tumor of a fourth patient has been reduced to a small nodule (Figs. 7 and 8). This might readily be excised, but it will probably disappear spontaneously in time. Two other patients are much improved. In one of these the tumor has reduced from a large mass covering the entire right side of the neck, extending from the left of the median line anteriorly to the median line posteriorly, and from the mandible to the clavicle, until at the present time there is only slight fullness and flabbiness of the superficial tissues in this region. Seven patients in the group have died from acute infection of the tumor. Four of the tumors were acutely infected at the time the patients first came under observation, and it became necessary to establish drainage in two of these. One of the patients was so ill that death promptly ensued in spite of the institution of simple drainage only. In several instances radium treatment was used during the height of the acute infection. This did not appear to aggravate the acute reaction nor was there any immediate, strikingly beneficial effect so far as the inflammatory process was concerned. In one case, however, in which a fatal termination was anticipated at the time, complete recession of the tumor has occurred without further treatment. How much the acute inflammatory process had to do with this result is questionable. If it was primarily responsible, this is the first instance that has come under my observation. There has not been any evidence to indicate that acute infections are more likely to occur in hygromas following radium treatment. Two of the patients that have died since

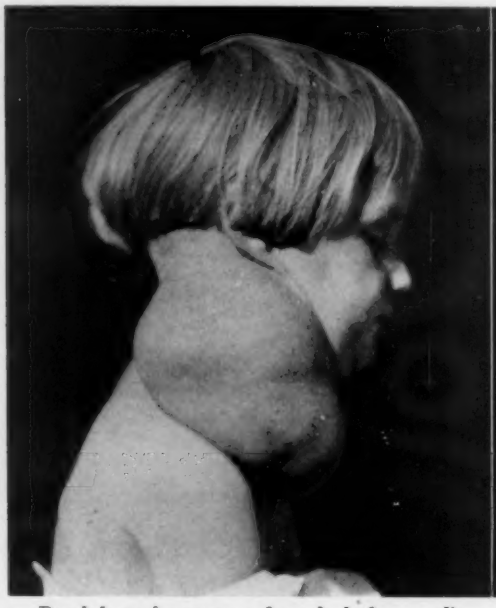

FIG. 9. Pendulous hygroma of neck before radium treatment.

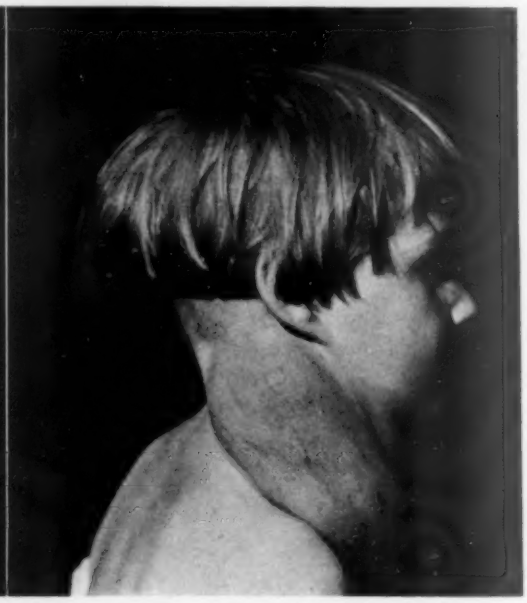

FIG. 10. Same patient as that shown in Figure 9, after radium treatment.

leaving the Clinic had each received only one radium application. Another patient had received nine radium applications and the tumor had reduced in size at least one-third when it became infected. Repeated drainage was carried out at the patient's home, once through the floor of the mouth, but the process terminated fatally. In still another case the tumor had been reduced in size markedly by five radium treatments when a similar infection developed. In one case there is very little difference in the size of the tumor from that present at the time treatment was started, about two years ago, in spite of the fact that six applications of radium at the Clinic and several applications elsewhere have been administered. For about sixteen months there was marked improvement under treatment and the tumor, a large pendulous mass, became soft and flabby and reduced to approximately one-fourth its original size (Figs. 9 and 10). However, a large mediastinal mass continuous with that in the neck was demonstrable in the roentgenograms, and this persisted with little change in size in spite of recession of the cervical tumor (Figs. 11 and 12). Following a recent attack of whooping cough the tumor has again rapidly increased in size, and is now as large and tense as at the time treatment was instituted. This unfortunate result is unquestionably due to persistence of the mediastinal extension which is present in many of these cases.

Fig. 11. Same patient as that shown in Figures 9 and 10. Mediastinal extension of cystic hygroma before radium treatment.

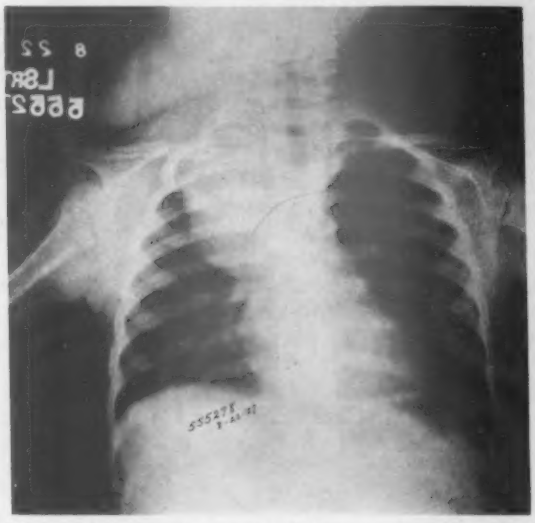

Fig. 12. Same patient as that in Figure 11, after radium treatment to the cervical mass; reduction in the size of the tumor of the neck without change in mediastinal extension is shown.

CONCLUSIONS

From experience with treatment by radium in 12 cases of multilocular lymph cysts in children, radium appears to be of definite value. The tumor may be reduced to such size as to permit surgical removal or it may disappear entirely.

REFERENCES

1. Bland-Sutton, John. Tumors, Innocent and Malignant. Seventh edition. Cassell and Co., London, 1922, 806 pp.
2. Borst, Max. Die Lehre von der Geschwülste, mit einem Atlas. J. F. Bergmann, Wiesbaden, 1902, p. 204.
3. Dowd, C. N. Hygroma cysticum colli, its structure and etiology. *Ann. Surg.*, 1913, lviii, 112–132.
4. Huntington. Quoted by Dowd.
5. McClure, C. F. W. Quoted by Dowd.
6. New, G. B. Giant cell tumor; solid odontoma; hygroma cystica; thyroglossal duct sinus. *Surg. Clin. N. Am.*, 1924, iv, 521–530.
7. Winslow, Randolph. Cystic hygromata and other tumors occurring in infancy. *Surg., Gynec. & Obst.*, 1917, xxv, 428–430.

ABSTRACT OF DISCUSSION

DR. HENRY SCHMITZ, Chicago. Dr. Figi had the kindness to refer one of these patients to me. She had been operated upon soon after giving birth to a child but had a very large multilocular fibroma which we treated with radium. It disappeared entirely for a time but recurred.

DR. G. E. PFAHLER, Philadelphia. I would like to ask Dr. Figi whether these growths are likely to become malignant if the patient reaches adult life. I would like to refer to an adult case which was thought to be a myxoma, which had supposedly developed from a branchial cyst. I treated the patient about eight years ago and she is still quite well.

DR. J. D. MORGAN, Philadelphia. I would like to ask whether, in the last case reported, the tumor in the mediastinum received special treatment, and whether it responded in any way. I had a case which was diagnosed as a branchiogenic cyst in a man aged fifty-five. It was opened surgically and drained immense quantities of clear fluid, but later became infected. He was referred to me for roentgen treatment. The tumor entirely disappeared under mild treatment over a period of three or four months.

DR. FIGI (closing). Radium treatment would not be likely to have any effect on a branchial cyst.

Malignant degeneration has not occurred in any of the cases of cystic hygroma seen in the Clinic and I have seen no report in the literature of its occurrence.

As regards the technique of the treatment and the dosage, the applications were made at a distance of 2.5 cm. using 2 mm. of lead screening, from 2000 to 7000 mg-hr. being administered at each treatment. The applications were repeated at intervals of two to three months. The dosage with each subsequent treatment was reduced somewhat, depending upon the skin reaction. The average number of treatments was four. The greatest number of treatments given in one case was nine. No treatment was given over the chest in any of the patients with intrathoracic extensions. Deep roentgen therapy might have been of some value in this regard.

THE CHEMICAL EFFECTS OF RADIUM RADIATION*

BY S. C. LIND

Director of the School of Chemistry, University of Minnesota

MINNEAPOLIS, MINNESOTA

IT is a special privilege to address this Society whose members are so intimately associated with the development of radium therapy in this country. Your distinguished President, Dr. Burnam, has not only been a leader in that field but through co-operation in the production of radium he and Dr. Howard Kelly greatly extended its usefulness at a very early and critical period. It was by means of radium produced in that co-operation[13] that many of the chemical effects that I shall bring to your attention have been investigated.

Although I assume that your interests in radium radiation are mainly therapeutic, it nevertheless gives me much pleasure to describe to you the chemical effects because I am convinced the two subjects have much in common. While employing the same kind of material for irradiation there is otherwise a rather wide gap at the present time between the chemical and the therapeutic methods of attack. You employ the most penetrating type of radiation, the gamma ray, to pass through and reach certain living tissues for the most effective irradiation. Unfortunately the gamma radiation carries but a small proportion of the energy radiated by radium. Therapeutically the non-penetrating but energy-rich alpha ray is practically useless, while the beta ray though sometimes useful, must in other cases be eliminated by screening.

In the study of the chemical effects the situation is almost reversed. To utilize the maximum of energy, we employ the alpha radiation. To compensate for its low degree of penetration as well as to make use of other experimental advantages, we most

* Address at the Thirteenth Annual Meeting, AMERICAN RADIUM SOCIETY, Minneapolis, Minn., June 11–12, 1928.

frequently operate in gaseous systems. In spite of the apparently great differences, essentially the two subjects undoubtedly depend on the same primary reactions. Indeed it seems to me quite probable that the therapeutic effects are reached through the intermediation of chemical reaction produced by the rays. We stand then on opposite sides of a chasm which it is our object to span. From the first slender thread of connection to the last solid keystone of the arch, I am confident that *ionization* will constitute the fundamental link between the two.

As soon as solutions of radium salts in water began to be used, the decomposition of water was observed and calculation showed that the number of molecules of water decomposed was approximately equal to the number of ions that the same quantity of alpha radiation would produce in air. This calculation was first made by Bragg[1] from data of Ramsay and Soddy.[14] While Bragg apparently regarded the agreement as accidental, it was early accepted by Mme. Curie,[3] Rutherford,[16] Duane and Scheuer,[4] and others, as indicating a fundamental relation between shock ionization and chemical reaction, since both are produced by alpha radiation and are equivalent to each other in quantity.

One imperfection marred the comparison, however, in that ionization *of air* was being compared with chemical decomposition *of water*. This difficulty was met by comparing ozone formation[8] and ionization simultaneously in the same medium —gaseous oxygen. The result again demonstrated the equivalence of ionization and chemical action since about one molecule of ozone was formed for each pair of positive and negative ions produced by the alpha radiation absorbed in flowing oxygen.

Comparison between ionization and a large number of gaseous reactions[9] was then made, giving practically the same result,—that there seemed to exist a direct relation between the number of ions produced in the gas or gaseous mixture and the number of molecules caused to react.

The possible reactions were found not to be confined to any one type but were very varied. Those of synthesis, condensation and polymerization were produced as well as those of decomposition. Even reactions proceeding in the direction opposed to the chemical free energy were found to show about the same degree of equivalence as those proceeding with it, the necessary energy in the latter case being supplied, of course, by the radiation.

This equivalence of ionization and chemical effect is very suggestive of Faraday's law in electrolysis. In the latter whenever one unit of electricity is discharged from an ion at the electrode, the ion enters into some kind of reaction producing one unit of chemical change for each electrical unit. In the reactions produced by ionization in gases through radiation, the ions are not discharged at an electrode but in the gas itself by recombination of the positive and negative charges.

The theory was proposed by myself among others that chemical reaction results from these gas phase recombinations in a way similar to electrolytic action. For a time it appeared that the equivalence factor might be the same as in Faraday's law, but as the cases of gaseous action were multiplied, it became evident that the number of molecules reacting per ion pair produced in a gas by alpha rays is not *one* but may exceed unity by fairly large numbers as high as 20. This need not appear surprising if we remember that for a given element or compound the gaseous ion is not always identical with the electrolytic one, and that we may have a variety of gas ions of the same atom or molecule, depending on the circumstances of their generation or subsequent history.

The experimental fact that several molecules may react per one ion pair indicates that the ions before recombination collect other neutral molecules into ion clusters which are also caused to react at the time of electrical neutralization. The idea of ion clusters was quite prevalent among physicists at one period, but has been more or less discarded owing to the failure of physical methods to furnish definite evidence of the existence of clusters larger than two molecules.[10] The deficiencies of the present physical methods of investigating gas ions at ordinary pressure are so

well recognized that it must be admitted that there remains a large margin of probability for the existence of gas ion clusters which are so strongly indicated by the chemical evidence.

I have emphasized, unduly perhaps, gaseous reactions because we have in some 50 or 60 investigated cases the best evidence on which the law of equivalence of ionization and chemical reaction rests. Before passing on to systems that I hope may be of more direct interest to you, I shall mention some of the principal types of gaseous reactions that have been studied:[9] The oxidation of hydrogen, of carbon monoxide, and of the hydrocarbons, methane, ethane, propane and butane; the decomposition of carbon monoxide (which partly condenses to a higher solid suboxide), of ammonia, of hydrogen chloride and bromide and of nitrous oxide; the synthesis of water, of ammonia, and of hydrogen chloride; the condensation of methane, of ethane, of propane and of butane; the polymerization of acetylene, of cyanogen and of hydrogen cyanide. The effect of the ions of foreign gases on many of the foregoing reactions has also been investigated. Throughout, the equivalence law has been demonstrated to hold.

Turning our attention to the effect of radiation on liquid and solid systems, alpha radiation has been employed in a few instances, but more frequently the penetrating rays from sealed tubes of radium salt. The decomposition of water and of liquid hydrogen bromide by alpha rays has been found to obey the equivalence law. Ice was found by Duane and Scheuer[4] to be decomposed by alpha rays but only about 5 per cent as much as water. On the other hand, Richards[15] has recently shown that both liquid and solid paraffin evolve hydrogen at about the same rate under alpha irradiation. From his data I have estimated[5] that the equivalence law holds with at least one-half of the yield per ion-pair of that in gaseous hydrocarbons.

In using beta rays, it is very difficult to operate with gases on account of their low absorption. Usher[17] compared the decomposition of water by alpha and beta rays under comparable conditions. The same quantity of radon decomposed about 75 times as much water by means of its alpha radiation as by its penetrating rays. From this it may be concluded that the yield per ion pair corresponds in both cases to normal equivalence. Kailan[7] has studied the effect of penetrating rays on various liquid systems including many organic liquids. In general, ionic equivalence is maintained with yields from 10 to 100 per cent of theory. On account of the great penetration and consequent small expense of energy per unit of path, gamma rays have not been exclusively employed in the study of chemical effects, but roentgen rays have been in a few instances. Recent papers by Fricke and Morse[6] indicate that the relation of chemical effect to ionization is the same as in the alpha and beta ray cases.

We therefore see that while the fields of radium therapy and chemical effects do not yet experimentally overlap at any points, they are approaching a common contact, with every prospect of a close relationship.

Finally, it may not be without interest to consider briefly some calculations with respect to the intensity of radiation necessary to produce certain effects in living tissue. From data on the dosage of radiation necessary to produce such effects as erythema, or mutation of species in animals or plants, or the killing of eggs and seeds, it may be readily calculated that it is not necessary to ionize every molecule in the system nor even a large fraction of them. This has led to the assumption that only certain especially sensitive portions must be attacked. A very interesting discussion of the probability relations for roentgen-ray quanta have been recently given by Condon and Terrill.[2] They estimate that one quantum of roentgen radiation from a 160 kv. source produces about 4000 ion pairs in a volume of less than one millionth of a cubic centimeter. For a cell volume of 4.10^{-7} mm.^{3} one estimates that there would be about 2,500 cells in the volume ionized by one 160 kv. quantum, which shows that about one to two ion pairs produced per cell suffice to cause a profound change, either to kill if it belongs to the sensitive portion of the organism, or to produce mutation if it be less sensitive.

It has also been suggested that in the case of the mutations the primary cause is a chemical action but that in the killing of the cell it may be the direct disturbance of certain colloid equilibria by the ionization which is responsible.

Soon after the recent investigation of Millikan of the penetrating cosmic radiations which reach the earth's surface, it was suggested that these play an imporant rôle in the mutation of plants and animals and hence in general evolution of species. More recently Olson and Lewis[12] have suggested and supported by some ionization calculations that the radiation of radioactive materials in the earth's surface and atmosphere play an equally important rôle in the evolutionary changes, just as roentgen rays have been shown to do. To avoid the necessity of assuming penetrating radiation and including the total ionization, as Olson and Lewis have done, it appears necessary to assume, however, that the effect be produced in the leaves or thinner tissues in plants or in the internal respiratory channels in animals, so that less penetrating forms of radiation such as the alpha and beta radiation from gaseous radon, active deposit, or radioactive dust particles in the atmosphere may also be taken into account. Suitable plant experimentation in a controlled atmosphere containing dilute radon could be carried out without great difficulty. In fact some observations on the retarding and mutational action of radon were made by Molisch[11] as early as 1912.

REFERENCES

1. Bragg, W. H. The ionization of various gases by alpha particles of radium. *Phil. Mag.*, 1907 (6), 13,333.
2. Condon, E. U., and Terrill, H. M. Quantum phenomena in biological action of *x*-rays. *J. Cancer Research*, 1927, xiv, 324.
3. Curie. Traité de radioactivité. Volume II, p. 247, Gauthier-Villars, Paris, 1910.
4. Duane, W., and Scheuer, O. Recherches sur la décomposition de l'eau par les rayons alpha. *Radium*, 1913, x, 33.
5. Ref. 9, p. 150.
6. Fricke, Hugo, and Morse, Sterne. The relation of chemical, colloidal and biological effects of roentgen rays of different wave lengths to the ionization which they produce in air. II. The action of roentgen rays on solutions of ferrosulphate in water. Am. J. Roentgenol. & Rad. Therapy, 1927, xviii, 426–430.
7. Kailan, Anton. Numerous papers in *Stizb. Vienna Acad.*, 1911. Summarized in: Über Reaktionen in der durchdringenden Radiumstrahlung und im Quarzglasultraviolett. II. Über das in der ersteren Strahlung sich einstellende Wasserstoffsuperoxyd-Gleichgewicht. *Ztscbr. Pbys. Chem.*, 1921, xcviii, 474.
8. Lind, S. C. The ozonization of oxygen by alpha-rays. *Am. Chem. J.*, 1912, xlvii, 397.
9. Lind, S. C. The Chemical Effects of Alpha Particles and Electrons. Second edition. Chemical Catalog Co., New York, 1928, p: 100.
10. Loeb, L. B., Erikson, H. A., and Wahlin, H. B. A number of papers in *Phys. Rev.* and elsewhere.
11. Molisch, H. Über das Treiben von Pflanzen mittels Radium. *Sitzb. Vienna Acad.*, 1912, cxxi, 121. Über den Einfluss der Radiumemanation auf die höhere Pflanze. *Ibid.*, cxxi, 833.
12. Olson, A. R., and Lewis, G. N. Natural reactivity and the origin of species. *Nature*, 1928, cxxi, 673.
13. Parsons, Chas. L., Moore, R. B., Lind, S. C., and Schaefer, O. C. Extraction and Recovery of Radium, Uranium and Vanadium from Carnotite. U. S. Bureau of Mines, Bulletin 104, 1916.
14. Ramsay, W., and Soddy, F. Experiments in radioactivity and the production of helium from radium. *Proc. Roy. Soc.*, 1903, lxxii, 204.
15. Richards, W. T. Note on the effect of alpha particles on paraffin. *Proc. Camb. Phil. Soc.*, 1927, xxiii, 516.
16. Rutherford, E. Radioactive Transformations. Scribner, N. Y., 1906, p. 253.
17. Usher, F. L. Die chemische Einzelwirkung und die chem. Gesamtwirkung der alpha und der beta Strahlen. *Jabrb. rad. Elektronik*, 1911, viii, 323.

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Information of interest to all readers will be found on page ii.

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EDITORIAL

RADIOSENSITIVITY OF BONE

WHILE numerous experiments have been carried out with regard to the radiosensitivity of many different organs of the body, practically no attention has been given to the question of radiosensitivity of bone. It has apparently been considered that bone is impervious to whatever action different radiations may exert on supposedly more delicate structures. Within the past few months at least three articles have appeared dealing with the effect of roentgen rays and other radioactive substances on bone. The subject is an important one and since an editorial in the *Journal of the American Medical Association** gives an excellent summary of the recent work, it seems well to bring the matter to the attention of radiologists by quoting the editorial in full:

"Because of its hardness and strength, to which characteristics it owes its adaptation to the physiologic function it has to perform, and because of the length of time it can withstand decay and other destructive agencies, bone is commonly considered the most resistant tissue of the body. It is, however, only as properties of dead material that the hardness and strength and resistance of bone are apparent. As a living tissue, bone yields readily to constant pressure, even of softer tissues, by undergoing atrophy and resorption, and it may be quickly destroyed in inflammatory and neoplastic processes.

"Resistance to radiation has also been ascribed to bone. Older tables of roentgen-ray dosages gave for bone a dose as much as eight times that for the skin of the face. With widespread use of the more deeply penetrating hard roentgen rays, bone has been found to be not immune to injury. Ewing[1] has described a form of chronic osteitis following irradiation, a proliferative process which is probably secondary to harm done rather than a primary stimulative reaction. More recently, Wynen[2] has discussed the occurrence of late necrosis in bones subjected to therapeutic irradiation by roentgen rays. The process has been noted in the jaw and in bones connected with the exterior by fistulous openings; in the first case in bone easily invaded by bacteria after harm has been done, and in the second case in bone that is already infected but further injured by radiation. Experimentally it was found by Wynen that the rootlets of seedlings were more severely injured when surrounded by bone and subjected to radiation than when surrounded by an equally thick layer of muscle, an action ascribed to the emission of secondary rays by the calcium of the bone. Similar secondary radiation, resulting in the death of individual bone corpuscles and in injury to the capillaries, is held responsible for the harm to bone that may result in late necrosis under the further influence of bacterial invasion. Too intensive irradiation of bone apparently introduces an element of danger which must be borne in mind in the application of the therapeutic procedure. Wynen warns especially against too heavy dosage in the treatment of bone and joint tuberculosis.

"Similar sensitivity of bone to radiation has been noted by Martland and his collaborators[1] as the result of the action of radioactive substances deposited in the bones of painters of luminous dials. In these unfortunates, not properly warned or protected against the hazards of a new occupation, widespread necrosis of the jaw occurred. Here also, as is the case after roentgen irradiation, secondary bacterial invasion of bone injured by radiation is a factor. The injury to bone in dial painters is much more severe than has yet been described after roentgen irradiation, because the action of the deposited radium and mesothorium compounds is continuous over a period of years, the bones of a body exhumed after five years of interment having been found to be strongly radioactive by St. George, Gettler and Muller.[2] Such continuous action leads not only to bone necrosis but also to diffuse radiation osteitis and to injury to the hemato-

* Apr. 27, 1929, xcii, 1447.

[1] Ewing, James. Radiation osteitis. *Acta radiol.*, 1926, vi, 399.

[2] Wynen, W. Die Radiosensibilität des Knochens in ihrer Bedeutung für die Röntgenbestrahlung der Gelenktuberkulose. *München. med. Wchnschr.*, Feb. 8, 1929, lxxvi, 244.

[1] Martland, H. S., Conlon, Philip, and Knef, J P. Some unrecognized dangers in the use and handling of radioactive substances. *J. Am. M. Ass.*, 1925, lxxxv, 1769.

[2] St. George, A. V., Gettler, A. O., and Muller, R. H. Radioactive substances in a body five years after death. *Arch. Path.*, March, 1929, vii, 397.

poietic system, the latter manifested by an anemia of either regenerative or aplastic type, which is one of the principal features of the effects of radioactive substances. As still another possibility in the chain of evils caused by the deposition of radioactive materials in bone, Martland's[1] most recent contribution calls attention to the occurrence of osteogenic sarcoma of bone in two dial painters. The proof that the tumor was actually caused by the presence of radioactive substance in the bone is not and cannot be absolute. About 70 per cent of the deposited material is mesothorium, the half-life of which is six and seven-tenths years. If the victim escapes death from bone necrosis or anemia during the early period of more intense radioactivity, he still remains subjected to a less intense degree of activity over a prolonged period. Such long continued but milder irritation may well be the cause of tumor formation, a possibility deserving consideration in the future history of those subjected to the intake of radioactive materials that may be deposited in the osseous system."

[1] Martland, H. S., and Humphries, R. E. Osteogenic sarcoma in dial painters using luminous paint. *Arch. Path.*, March, 1929, vii, 406.

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SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

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United States of America

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Secretary, Dr. John T. Murphy, 421 Michigan Ave., Toledo, Ohio.
Thirtieth annual meeting: Hotel Pennsylvania, New York City, Sept. 17–20, 1929.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, Portland, Oregon, 1929.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Portland, Oregon, July 8–12, 1929.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Walter T. Bronson, Northwestern Univ. Med. School, Chicago, Ill.
Fifteenth annual session: New Royal York Hotel, Toronto, Canada, Dec. 2–6, 1929.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Lowell S. Goin, Wilshire Medical Building, Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
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CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

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Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.
Next meeting in Evansville, Ind., June, 1929.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Annual meeting, Charlottesville, Va., Oct. 18, 1929.

British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London, W. 1.

*Secretaries of societies not here listed are requested to send the necessary information to the editor.

Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Third session, Sydney, Sept. 2–7, 1929.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION

Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.

Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RONTGENKUNDE UND STRAHLENFORSCHUNG)

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA

Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.

Secretaries, Drs. S. A. Reinberg and S. G. Simonson.

Meets annually.

Sixth Annual Meeting, 1929, to be announced.

LENINGRAD ROENTGEN RAY SOCIETY

Secretaries, Drs. S. G. Simonson and G. A. Gusterin.

Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY

Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.

Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN

Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY

Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK

Secretary, Dr. O. Wissing, Copenhagen

Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND

Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY

Secretary, Professor Holzknecht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

RESOLUTIONS ADOPTED BY THE CHICAGO ROENTGEN SOCIETY

At a metting of the Council of the Chicago Roentgen Society held on February 5, 1929, the following resolutions were adopted:

WHEREAS, there are at this time several large buildings in the loop and adjoining

business district of Chicago, which have negotiated exclusive leases for space in which to practice roentgenology, and

WHEREAS, if the aforementioned practice of giving exclusive leases in this district be continued and extended to buildings now in the course of construction and being planned, there will be practically no desirable space available for roentgenologists, and

WHEREAS, the specialty of roentgenology is a medical branch and a true medical specialty, as much so as is surgery, neurology, ophthalmology, gynecology, pedriatics, orthopedics, etc., etc., and is consequently of paramount importance to public and private health, in the diagnosis and treatment of disease, and

WHEREAS, exclusive leases are never even considered, much less asked for, by any of the other medical specialties, or given to any of them, and

WHEREAS, this giving of exclusive leases is discriminatory against roentgenologists, because of the reasons previously herein set forth, therefore, be it

RESOLVED, by the Chicago Roentgen Society, that the giving of exclusive leases in any building, to any medical specialists, is wrong, is in bad form, is an unjust discrimination against that specialty and, it is further

RESOLVED, that The Building Managers Association of Chicago, be and are hereby most earnestly and urgently requested to cease the issuance of any exclusive leases to any medical specialist, be it surgeon, psychiatrist, gynecologist, pedriatician, or roentgenologist, and that at the termination of existing exclusive leases these be not renewed, and it is further

RESOLVED, that copies of these resolutions be transmitted to the aforementioned Building Managers Association of Chicago, the Chicago Association of Commerce, and to the editors of Radiology, The American Journal of Roentgenology, The Bulletin of The Chicago Medical Society, and to the Council on Medical Education and Hospitals of the American Medical Association, the American College of Surgeons, The American College of Radiology, and The American College of Physicians.

ATTEST:

Walter T. Bronson, M.D.
Secretary-Treasurer.

MILWAUKEE ROENTGEN RAY SOCIETY

The last meeting of the Spring of the Milwaukee Roentgen Ray Society was held at 6 P.M. Saturday, April 6, at the Sacred Heart Sanatorium where the members and invited guests were entertained at dinner by the medical staff and the Sisters of the Sacred Heart Sanatorium. Following the dinner, which was held in the large dining room of the recently completed new wing, the scientific program was presented which included case reports of "A Spinal Tumor" by Dr. S. S. Stack, Jr., "Stomach Ulcer" by Dr. J. C. Metz and "Multiple Myeloma" by Dr. F. W. Mackoy; "Newer Knowledge of Pyogenic Infection of Bone" by Dr. Dallas B. Phemister, professor of surgery at Chicago and "Roentgen Signs of Circulatory Diseases" by Dr. Fred J. Hodges, Madison, Wisconsin.

AMERICAN ROENTGEN RAY SOCIETY

The Thirtieth Annual Meeting of the American Roentgen Ray Society will be held at the Hotel Pennsylvania, New York City, September 17, 18, 19 and 20, 1929. The Pennsylvania Hotel is one of the largest and most centrally located hotels in New York and it offers adequate accommodations not only for the members of the Society and its guests but its physical arrangements are such that the Society will have ample space at its disposal for the scientific meetings, the commercial and scientific exhibits to be held on the same floor. In spite of the numerous hotels in New York accommodations are sometimes difficult to be had and it is recommended that reservations be made early.

The preparation of the scientific program is well under way, and it is a matter of considerable satisfaction for the President-elect to be able to announce that Dr. Frederick H. Baetjer of the Johns Hopkins Medical School has consented to give the Caldwell Lecture. Dr. Baetjer needs no introduction to this Society which has long been honored to call him one of her members. A pioneer in the field of roentgenology, his ability as a teacher and investigator in this branch of medicine makes his choice as Caldwell lecturer a happy one and the Society is to be congratulated on the prospect of having him contribute to the program of the meeting.

The success of the meeting is still further assured by the announcement that Dr.

Chevalier Jackson of Philadelphia will speak on some subject allied to roentgenology. The program promises to be a well-balanced one as several symposia have been arranged. A symposium on "The Treatment of Malignant Disease" will be participated in by Dr. Greenough, Dr. Simpson, Dr. Burton Lee and several others. A symposium on "Diseases of the Skull" has been arranged by Dr. Sosman and will be participated in largely by men from the Peter Bent Brigham Hospital. Dr. Holmes has arranged a symposium on "Diseases of the Heart"; Dr. Pendergrass has arranged one on "Diseases of Children."

It is evident from this that the high standards of the past are to be maintained at the forthcoming meeting in New York. The clinical facilities of the New York hospitals are unsurpassed, and the President-elect is glad to announce that clinics have been arranged in several hospitals and an opportunity will be given to everyone to visit the various institutions.

Dr. Imboden, the president-elect, will welcome suggestions with regard to the meeting and those who have papers to present should address their communications to Dr. H. M. Imboden, 30 West 59th St., New York City.

SCIENTIFIC EXHIBIT

During the past few years the scientific exhibit of the American Roentgen Ray Society has formed a very interesting and informative part of the meeting. It is to be hoped that this year's exhibit at the meeting to be held at the Hotel Pennsylvania, Sept. 17–20, will prove no exception other than in the direction of a larger and still better one. Dr. Webster W. Belden, 8 West 16th St., New York City, who is chairman of the scientific exhibit is anxious to hear from any members desirous of having an exhibit and he urges them to communicate with him as soon as possible.

PREMIER CONGRÈS INTERNATIONAL D'ACTINOLOGIE

The First International Congress of Actinology will be held in Paris, July 22–27, 1929 at the Grand Palais of the Champs-Elysees (Coupole d'Antin). This Congress has been organized by l'Institut d'Actinologie. Many questions of importance to this subject will be discussed. The Congress is interested in learning the state of scientific light therapy in the United States and the director of the Institute, Dr. Saidman, extends a cordial invitation to Americans to attend this Congress and to participate in the proceedings. Those wishing to present papers should communicate at once with Dr. Dufestel, Secrétaire général, 150, Boulevard Pereire, Paris.

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

A PORTABLE ELECTROSCOPE INCORPORATING SOME UNUSUAL FEATURES*

BY FRANCIS W. BISHOP

ROCHESTER, NEW YORK

SINCE it is the policy of this laboratory to describe, from time to time, new devices which have been built here, or modifications of existing equipment that may be of general interest, a portable electroscope is described which has certain unusual features. It is generally recognized that, for measurements of roentgen-ray and radium dosage, some sort of ionization system is the most practical. Our experience with such devices has led us to conclude that, for general purposes, the electroscope, or some modification thereof, is an extremely valuable instrument. An electroscope has the advantage over certain other instruments in that it can be made extremely rugged, readily portable, and is relatively easy to repair and calibrate.

The instrument depicted here seems to fulfill the requirements and has proved to be quite fool-proof and reliable, over a period of two years. During this time the instrument has been transported approximately 1500 miles, most of the time in the back of an automobile. There has been no noticeable change in the calibration in spite of this hard usage.

The construction of this electroscope was completed at the Massachusetts General Hospital, Boston, and was used there for about a year. Several modifications and accessories have since been added which have contributed to its flexibility.

The case of the electroscope is made of 0.32 cm. (⅛ in.) brass, lined completely with 0.65 cm. (¼ in.) lead. This case is rectangular in shape, 27 cm. long, 9 cm. wide, and 18 cm. high, outside dimensions. A removable leather handle is supplied for carrying. A disc of brass, carrying a number of filters is attached to the end of the electroscope facing the roentgen-ray tube, permitting, by simple rotation, the use of any desired filter for effective wavelength determinations (Fig. 1).

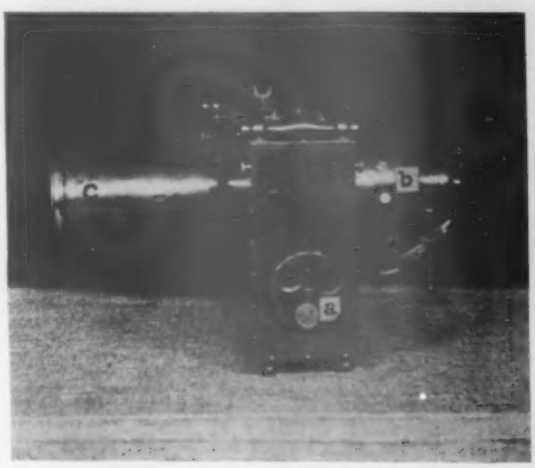

Fig. 1. Front view of electroscope showing: (*a*) filter carrier; (*b*) lamp, and (*c*) scale arrangement.

The shadow of the leaf system is usually projected upon a small screen while, for special work, the image can be thrown upon a large scale at a reasonable distance from the electroscope. For ordinary use, the lamp and scale are mounted in 6.4 cm. (2½ in.) brass tubing, 16 cm. long, arranged to slide into channels on opposite sides of the electroscope case, thus permitting quick and easy substitution if it is more convenient to read the electroscope from the opposite side. A lens to focus the shadow of the needle onto the scale is provided. For teaching purposes, as well as to allow for any adjustments to be made, one side of the instrument is hinged

* From the Department of Radiology, Strong Memorial Hospital, and the University of Rochester, School of Medicine and Dentistry, Rochester, N. Y.

at the bottom, permitting this side to be opened fully (Fig. 2). A 1.5 cm. conduit for the passage of the roentgen beam to the ionization chamber is constructed of 0.32 cm. (⅛ in.) lead and is about 17 cm. long. This serves as a diaphragm to limit the cross-section of the roentgen beam. For experimental purposes, smaller diaphragms can be used. An additional 0.65 cm. (¼ in.) lead partition serves to protect the charged parts of the electroscope from direct radiation as well as to separate the ionization chamber from the charging mechanism (Fig. 2).

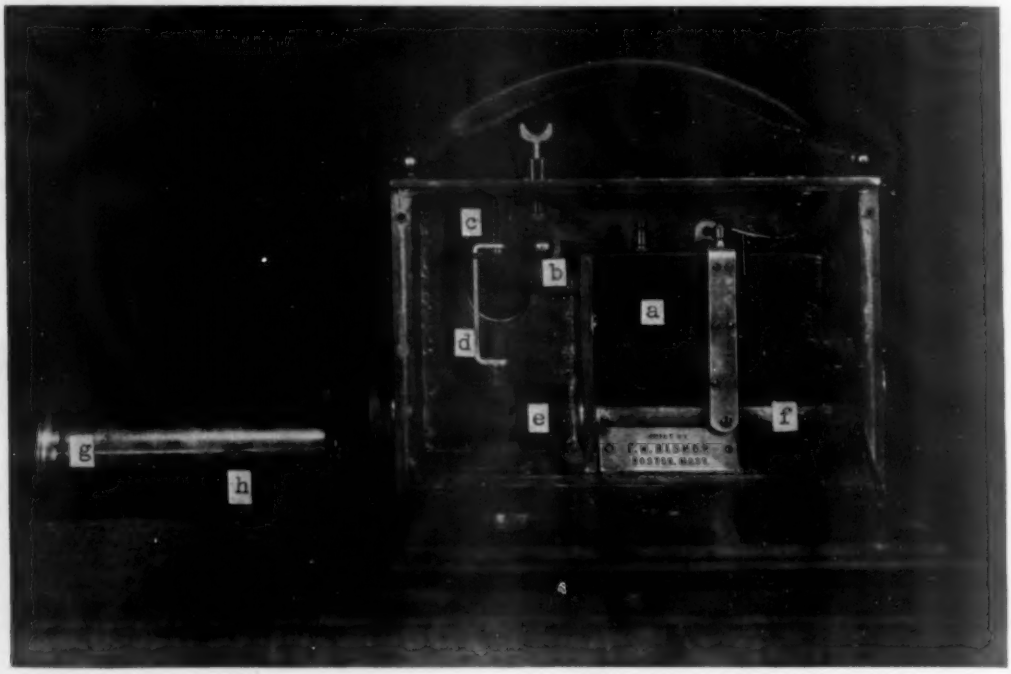

FIG. 2. Side view of electroscope showing interior: (*a*) coil charger; (*b*) rectifying gap; (*c*) amber insulator; (*d*) electroscope; (*e*) ionization chamber; (*f*) conduit for roentgen rays; (*g*) scale, and (*h*) lens adjustment.

The charging apparatus consists of a small induction coil with a rectifying spark gap, both of which are built in the space in front of the ionization chamber. A study of the literature reveals a similar device described by Taft.[1] The coil is usually operated by a small bell ringing transformer. If no alternating current power is available, a couple of dry cells are used. The circuit is closed from a distance by a small hand push button. This makes it possible to recharge the electroscope without interrupting the roentgen-ray exposure. The usual manual charging arrangement using a hard rubber rod is also provided. The coil charger is very much superior, since it will operate equally well in any weather, while in damp weather it is very difficult to charge a hard rubber rod or similar friction device. The ionization chamber proper consists of two parallel carbon plates 5.5 cm. in diameter, separated by a distance of 2.5 cm. When charged, these plates assume a potential of some 5000 volts. At the end of the recorded discharge, the plates still retain a charge of 800 volts. This is more than sufficient to insure saturation currents at the highest available intensities. The upper carbon plate is attached to a flat aluminum bar which is rigidly fastened at the other end to an amber insulator. The sphere of the rectifying gap is also connected to the aluminum bar at this point. The needle or vane of the electroscope is suspended from a cross hair of silk fiber and silver wire, 0.002 in. in diameter, the wire being used to provide electrical contact between

[1] Taft, R. B. Charging device for electroscope. *Radiology*, 1926, vii, 513–514.

the needle and the fixed element of the electroscope.

Filaments of various kinds were tried, and one of aluminum which fulfilled the requirements was finally selected. Carbon filament which was available to us showed a rather large voltage drop along its length and was, therefore, finally discarded. Properly prepared carbon filament is very satisfactory, however. Our aluminum filament was prepared from aluminum foil.

The rear end of the electroscope case has a window which permits the proper alignment of the instrument in respect to the roentgen tube. A threaded flange is provided around the window upon which a cap is screwed whenever measurements are made of a roentgen-ray beam. This cap is leaded to absorb the measured beam, and additional aluminum filters are placed over the lead to absorb secondary radiation which might re-enter the electroscope to render readings unreliable.

For the measurements of radium and radium seeds, a cap containing adequate filters is screwed to the threaded flange at the rear of the electroscope. A v-shaped trough mounted on the cap into which the needles are placed, makes it readily possible to duplicate the position of the radium in respect to the ionization chamber. A standard radium needle is available to check the electroscope at any time.

For phantom measurements and certain experimental work, we have constructed a cable and several ionization chambers. The cable attaches at the rear window (Fig. 3). Contact with the electroscope is made by a small bronze spring. The ionization chambers are not unusual and need not be described but the cable merits special reference. It is a rather simple matter to build a non-flexible cable with a very small natural leak. Flexible cables, however, require special care and the best of insulation. Very often amber beads are used. Such cables, while they fulfill the electrical requirements, are very expensive and difficult to make. The cable described here is flexible and the insulation is of ceresin. A 15 foot length of 1 in. copper braid tubing and an equal length of 1 in. rubber tubing were procured. The copper braid was forced over the rubber tubing. The ensemble was then forced through a brass tubing which straightened all curves in the cable. A rubber covered wire was passed the length of the cable and was centered and tightened by means of stoppers. Melted ceresin was poured into the cable and allowed to cool and harden. Manipulation of the cable broke the ceresin into macaroni-like beads, making it flexible yet retaining the insulating properties of the ceresin. Amber plugs completed the insulation at the ends of the cable. The amber was later removed because of a slight leak and ceresin substituted. Fittings were made to attach the cable to the electroscope as well as various ionization chambers on the opposite end.

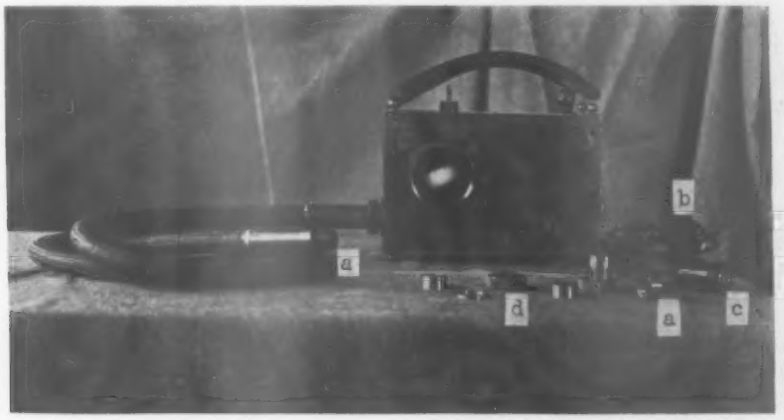

Fig. 3. Side view of electroscope showing scale illuminated and cable attached: (*a*) ionization chambers; (*b*) transformer which operates coil charger; (*c*) charging button; (*d*) accessories for radium measurements, etc.

The natural leak of the electroscope is

from two to four days, depending upon the humidity. The leak with the cable connected is about the same time. This is quite satisfactory considering the fact that the cable is made of inexpensive material and is obliged to stand a charge of 5000 volts.

From our experience with ceresin, we recommend it as an insulator for use in ionization instruments in preference to sulphur, etc., and, in certain cases, to amber.

SUMMARY

A rugged, portable electroscope has been described, having the following features: a simple charging device operable at a distance; provision for measuring radium and radium preparations, as well as roentgen rays, with exceptionally good protection from stray radiation.

An inexpensive, flexible cable with particularly good insulation allowing the use of detachable ionization chambers, is also described.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

ERGEBNISSE DER MEDIZINISCHEN STRAHLENFORSCHUNG (RÖNTGENDIAGNOSTIK, RÖNTGEN-, RADIUM- UND LICHTTHERAPIE). Volume III. By H. Holfelder, Frankfurt a. M., H. Holthusen, Hamburg, O. Jüngling, Stuttgart, and H. Martius, Göttingen. Paper, price 68 Marks; bound, price 72.50 Marks. Pp. 791, with 613 illustrations. Leipzig: Georg Thieme, 1928.

The volume under review does not really need an introduction because its quality and usefulness have been established.

The first two monographs are written by Otto Steurer (Tübingen), and relate the value and limitations of roentgen diagnosis in diseases of the nose, of the sinuses, and of the ear. Arthur Schüller (Wien), well known to many American roentgenologists contributes a chapter on the roentgen diagnosis of tumors of the acoustic nerve. The progress made in the diagnosis of diseases of the bronchi is set forth in an article by Ludolph Brauer and Alexander Lorey (Hamburg). It is conservatively written and gives a clear idea of the present status of the value of the injection method. The next monograph "The roentgen examination of the esophagus" by Werner Teschendorf (Koln) impresses one as a very careful clinical study.

That the Russian roentgenologists have resumed their scientific activities is shown in an article by Jakob Dillon (Moscow), who discusses the persistent unilateral elevation of the diaphragm (diaphragmatic hernia and eventration). Although considerable literature exists on this subject—in 1923 over 130 cases had been reported and the author himself has seen 35—relatively little is known regarding etiology and pathogenesis of this disease. Felix Fleischner (Wien) reports on intestinal tuberculosis in the roentgenogram, followed by a well-written essay by Viktor Gottheiner (Berlin) on the roentgen diagnosis of the appendix. A very timely subject has been allotted to Guiseppe d'Amato (Hamburg), who reports the results of the roentgen laboratory of the Eppendorf Hospital, with cholecystography. While this problem cannot be called a closed one by any means, a careful study of his contribution will help to clear up many a pending question.

Nicolai Stern (Saratow) who has observed 26 cases of echinococcus in the lungs, the histories of which are tabulated in condensed form, presents a chapter on diagnosis and treatment of that disease. From his compiled statistics, it appears that an average of 10 per cent of all observed echinococcus cases involved the lungs.

A very interesting chapter "Radiobiology of the normal skin" is presented by Hans R. Schinz (Zürich) and Benno Slotopolsky, (Frankfurt a. M.). The histological changes following irradiation have been studied and an attempt is made to place the primary point of attack of radiation on the cell. Then follows a review of the effect of light exposure on metabolism by Artur Lippmann (Hamburg).

The next monograph, written by Erich Schempp (Tübingen) relates the radiation therapy of the basal fibroid, a tumor observed in the nose and in the pharynx of young individuals, particularly males; 73 per cent of the cases are said to belong to the age of ten to twenty-five years. In the author's experience, roentgen therapy is the method of choice. The last chapter of the book brings a review of Ludwig Schoenholz (Düsseldorf) on the application of diathermy in gynecological diseases.

All contributions are well illustrated. They have also good bibliographies appended which may serve as reference for those interested in any particular subject. If the high standard of these first volumes is maintained, there should be no doubt regarding the welcome of the next volume.

ERNST A. POHLE.

TEETH AND JAWS ROENTGENOLOGICALLY CONSIDERED. (Annals of Roentgenology, Volume v.) By Herman A. Osgood, M.D. Second edition revised. Cloth. Price, $10.00. Pp. 135, with 419 illustrations. New York: Paul B. Hoeber, Inc., 1929.

The outstanding feature of this book is the excellent manner in which the illustrations are presented. Contrary to the usual method, the author has presented his objects for study in the "negative" instead of the positive. This makes for easy interpretation of the reproduced roentgen films.

Much also can be said in a complimentary fashion of the text of the book. Seldom does one find such a finished product in both illustrations and printed matter as is presented by Dr. Osgood.

Compared with the first edition we find several minor changes. The bitewing technique for studying crowns of teeth for dental caries (brought out by Raper) is considered in detail. The intraoral stereoscopy is elaborated upon. A chapter has justly been devoted to the pulpless tooth and its problems.

The author states that he has attempted to standardize the shadow values in the film and to show the correct evaluation of the structural changes in the pericementum and alveolar bone in terms of pathology. He has done admirably.

JOSEPH J. TOLAN.

THE TECHNIC OF ORAL RADIOGRAPHY. By Clarence O. Simpson, M.D., D.D.S., F.A.C.D., Professor of Radiodontia in the Washington University School of Dentistry, St. Louis, Mo. Second edition. Cloth. Pp. 207, with 165 illustrations. St. Louis: The C. V. Mosby Company, 1928.

While some minor changes and additions have been made in the text, the second edition of this book remains essentially the same as the deservedly popular first edition.

It describes in detail and with many illustrations an exact and definite procedure for the roentgen examination of the mouth and teeth. The book is worthy of the careful study of all practitioners and students of oral roentgenography who wish to systematize their work and produce uniform roentgenograms.

L. M. CHRISTIE.

BOOKS RECEIVED

OLD AGE: THE MAJOR INVOLUTION; THE PHYSIOLOGY AND PATHOLOGY OF THE AGING PROCESS. By Aldred Scott Warthin, PH.D., M.D., LL.D., Professor of Pathology and Director of the Pathological Laboratories in the University of Michigan, Ann Arbor. Cloth. Price, $3.00. Pp. 199, with 29 illustrations. New York: Paul B. Hoeber, Inc., 1929.

THE TECHNIC OF ORAL RADIOGRAPHY. By Clarence O. Simpson, M.D., D.D.S., F.A.C.D., Professor of Radiodontia in the Washington University School of Dentistry, St. Louis, Mo. Second edition. Cloth. Pp. 207, with 165 illustrations. St. Louis: The C. V. Mosby Company, 1928.

JAHRESBERICHT RADIOLOGIE: BIBLIOGRAPHISCHES JAHRESREGISTER DES ZENTRALBLATTES FÜR DIE GESAMTE RADIOLOGIE. Herausgegeben von Dr. K. Frik, Berlin. Band 1, Bericht über das Jahr 1926. Paper. Price, RM. 38.80. Pp. 388. Berlin: Julius Springer, 1929.

DAS THORAXRÖNTGENBILD DES NORMALEN SÄUGLINGS (LEHMANNS MEDIZINISCHE ATLANTEN, BAND 17). Von Privatdozent Dr. Erich Saupe und Dr. Kurt Ehle. Paper, price 6 Marks; bound, price 8 Marks. Pp. 41, with 26 illustrations. München: J. F. Lehmann, 1929.

LA GRANULOMATOSE MALIGNE (LYMPHOGRANULOME). Étude anatomo-clinique, étude thérapeutique, spécialement du point de vue de la roentgenthérapie. By Docteur Léon Babaiantz, Assistant a l'Institut Central de Radiologie de l'Hôpital Cantonal de Genève (Médecin-Chef: Dr. R. Gilbert). Paper. Pp. 175, with illustrations. Lusanne, Switzerland: Payot & Cie, 1928.

EM TORNO DA ARTERIA PULMONAR (NOTAS DE RADIOLOGIA CLINICA). By Adriano de Azevedo Pondé. Paper. Pp. 104, with 22 illustrations. Bahia: A Nova Graphica, 1928.

Report on Fourth International Congress of Military Medicine and Pharmacy, Warsaw, Poland, May-June, 1927. By Commander William Seaman Bainbridge, M.C.-F., United States Naval Reserve, Member of Permanent Committee, Delegate from the United States. Cloth. Pp. 248, with numerous illustrations. Menasha, Wisconsin: George Banta Publishing Company.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Arkussky, J. I. The question of early diagnosis of gastric neoplasms. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 686–695.

The author advocates, in addition to the examination of a barium filled stomach, in horizontal and vertical planes, an examination in the prone position with a 45 degree declination of the cranial end which permits the study of defects localized to the posterior wall of the lower portion of the stomach which otherwise could not be detected. The method is advocated as an adjunct to other methods. Five cases are described where the diagnosis was possible only by the use of this additional method.—*T. Leucutia.*

Arntzen, Leif, and Helsted, Alfred. Reduction under fluoroscopy of acute intussusception in children. *Acta radiol.*, 1928, ix, 592–599.

Two cases are described—of patients seven months and twelve years of age—in which roentgenoscopic examination revealed a diagnosis of intussusception with exact localization of the lesion. In both cases the intussusception was reduced under the roentgenoscope.—*T. Leucutia.*

Bronner, Hans. Cholecystographic emptying of the gall-bladder and its interpretation. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1929, xxxix, 23–76.

I. *A Short Review of Different Motility Tests of the Gall-Bladder.* Cholecystography is of great importance since it permits a study of the emptying of the gall-bladder. The author gives a résumé of the different functional tests dealing with the emptying of the gall-bladder. Boyden was the first to investigate the emptying of the gall-bladder by means of the so-called Boyden meal (4 egg yolks plus 280 c.c.—½ pt.—cream). He found that there is a functional cycle consisting of three phases: the slow emptying followed by a period of relaxation and again by slow refilling of the gall-bladder. Cholecystograms at intervals showed that within one hour and forty minutes from the ingestion of the meal, the gall-bladder had shrunk from the fully distended condition to the phase of collapse. Later Whitaker, Sosman and Edson used food rich in fat (mostly butter) and they also found a rapid emptying of the gall-bladder. The author, in rechecking these observations, compared them in a first series of experiments with the use of other meals; in a second series, with the intraduodenal injection of Witte's peptone, sulphate of magnesium and olive oil, and in a third series with the subcutaneous injection of pituitrin or hypophysin (2 c.c.), and arrived at the conclusion that Boyden's meal produces the fastest and promptest emptying of the gall-bladder.

II. *The Author's Method of Procedure.* Patients are prepared for a period of two days by special dieting, laxatives, etc., and from 12 o'clock on the second day they are kept fasting. Between 10 and 11 o'clock at night 4 gm. tetragnost (Merck) in 40 c.c. distilled water is injected intravenously during a period of fifteen minutes. The patient is again kept fasting until the first roentgenogram is taken between 10 and 11 A.M. next morning. Thus the fasting period lasts for twenty to twenty-two hours which is necessary in order to provoke a good emptying of the gall-bladder, since it is known that the longer the fasting period, the more active the response of the gall-bladder to emptying stimuli. Immediately following the taking of the first roentgenogram, the yolks of 3 fresh eggs (this proving as satisfactory as the Boyden meal) are administered to the patient. Then further roentgenograms are taken ten to fifteen minutes p.c., thirty to thirty-five minutes p.c., forty-five minutes p.c., and one to one and a quarter hours p.c. In case the roentgenogram taken fifteen minutes p.c. already shows emptying, the other roentgenograms are made somewhat sooner.

III. *Types of Emptying.* The author distinguishes three types of emptying of the gall-bladder: (*a*) The very rapid emptying of the parasympathetically irritable individuals. This begins immediately following the ingestion of the egg yolk; at fifteen to twenty minutes the emptying is half completed and at forty-five to fifty minutes there is total emptying. Another characteristic symptom of these parasympathetic gall-bladders is that in 80 per cent of the cases all gall ducts are visualized on the roentgenogram. (*b*) Normal emptying of the gall-bladder. This begins ten minutes following the ingestion of the egg yolk; at thirty minutes the emptying is half completed and at one to one and a quarter hours there is total emptying (one-sixth to one-seventh of the

fluid left being considered as normal residue). Here the cystic duct is visualized in 60 per cent and the common duct in 25 per cent of the cases. (c) The gall-bladder of duodenal and gastric ulcer. This type resembles very much that of the parasympathetic gall-bladder, with the exception that the emptying is still faster, there being a very marked hypermotility of the gall-bladder. The emptying begins immediately and within twenty to twenty-five minutes is entirely completed (the residue forming only about one-twentieth of the total fluid).

IV. *The Phenomenon of Emptying of the Gall-bladder as Observed in Roentgenograms.* The first phenomenon of emptying is an increased tone of the wall of the gall-bladder. The time elapsing between the increased tone and the actual beginning of emptying is called the latent period. The tone and latent period were studied both after administration of egg yolk and injection of pituitrin. It was observed that the ingestion of egg yolk produces a greater increase in the tone as well as an earlier emptying of the gall-bladder as compared to the injection of pituitrin. The emptying once having started there is no difference between the egg yolk and the pituitrin injection. The author reviews briefly the literature with regard to the change in shape which might be interpreted as peristalsis. He found that most authors agree on the point that although there is evidence of areas of contraction there is no direct peristalsis present. It appears that the fixation of the liver has a great influence on the mechanism of these contractions. This fixation is also responsible for the fact that the gall-bladder does not empty entirely. There is always one-sixth to one-seventh residual bile. The period of collapse as well as the refilling of the gall-bladder was not studied in the author's investigations.

V. *The Ampulla.* No contractions are observed in the region of the ampulla, but an expelling action somewhat similar to that of the analogous part of the stomach cannot be denied. This expelling action is responsible for the changes in form sometimes seen in the roentgenograms.

VI. *The Roentgenogram of the Gall Ducts.* As already mentioned, in the rapid emptying type of gall-bladders the gall ducts are visualized in 80 to 90 per cent while in the gall-bladders with normal emptying time the cystic duct is visualized in 60 to 70 per cent and the common duct in 75 per cent. The back-flow into the hepatic duct is an exceptional occurrence and is the sign of a pathological condition.

VII. *Contribution to the Ptosis of the Gall-bladder.* A ptotic gall-bladder is characterized by a complete atonicity of the wall. In the roentgenogram taken in horizontal position this results in a high position of the fundus as well as in an arrangement of the fundus, ampulla and cystic duct in a straight line.

VIII. *The Gall-bladder in Old Age and in Early Childhood.* A very small residual bile is a characteristic sign of a gall-bladder of early childhood, while an increased amount of residual bile indicates a gall-bladder of old age.

IX. *The Extrahepatic Gall Duct System in Ulcer Patients.* In examining the influence of ulcer on the gall-bladder the author found the following signs more or less characteristic: (1) in 16 per cent of ulcer patients there was no filling of the gall-bladder; (2) in 84 per cent where there was good filling, the emptying of the gall-bladder was extremely rapid so that this sign is pathognomonic; (3) all gall ducts are well visualized in the majority of cases; in 30 per cent there was also a back-flow into the hepatic duct; (4) there was evidence of gallstones with pericholecystic adhesions in a few instances (16 per cent).

As a result of his detailed investigations, the author arrives at the conclusion that cholecystography can be used as a functional test not only for the diagnosis of intrinsic lesions of the gall-bladder but also for extrinsic lesions more distant than pericholecystitis, as for example, in many cases of gastric and duodenal ulcer. A bibliography of 120 references is appended. —*T. Leucutia.*

DOUB, HOWARD P. Fuso-spirochetal pulmonary gangrene. *Radiology*, 1928, xi, 333–337.

Fuso-spirochetal pulmonary gangrene has become, during the past few years, a well recognized clinical picture. Bacterial studies of the sputum reveal fusiform bacilli, spirochetes, and other bacteria, especially streptococci. Post-mortem examination reveals an abundance of fusiform bacilli and streptococci, and a few spirochetes in the smears. Sections of the surrounding tissues, including the abscess wall, usually reveal large numbers of spirochetes.

In cases where the disease is primary the onset may be sudden, with an initial chill. This is followed by general malaise and pain in the chest, with cough. The temperature is elevated and usually irregular. The general condition gradually becomes worse, with loss of strength and the development of cyanosis. The sputum gradually becomes more abundant. It is purulent, of a greenish yellow color, and is always fetid.

In the aspiration cases the onset is usually from three to six days following infection and the foul expectoration comes on in from twelve to fourteen days.

On physical examination these cases commonly give the signs of a gradually developing bronchitis, but frequently the findings are indefinite. Bronchopneumonia is found in certain cases. Gangrene may be either diffuse or in scattered foci, and goes on to the development of abscess cavities.

The roentgen-ray findings vary somewhat according to the location of the lesion and the ease with which the pulmonary resistance is overcome. In some cases the roentgen changes are those ordinarily seen in aspiration pulmonary abscess, except that these abscesses are not likely to be so circumscribed in appearance. They excavate rapidly, with the production of large amounts of extremely foul-smelling sputum. The inner wall of this abscess cavity may be rather dense and thick but around this will be seen a hazy shadow representing infiltration extending into the surrounding lung tissue. They may progress in a period of ten days from a small area of consolidation to complete excavation of the lower lobe of the lung. As softening occurs and emptying follows, the usual air-containing cavity will be seen. Such a cavity frequently contains fluid, and, if of sufficient size, a fluid level will be present.

In cases presenting the findings of gangrene the shadows are much more diffuse, suggesting areas of pneumonia. When these lesions break down they are likely to cavitate in several places at the same time. These may then coalesce, with involvement of a large portion of the lung.

When this infection complicates an already existing bronchiectasis, the pre-existing shadows become more diffuse, gradually spreading over the base of the lung and causing a more or less uniform involvement. These also break down, with the formation of multiple cavities and the expectoration of a foul-smelling sputum. Occasionally these cavities rupture into the pleural cavity, with the formation of an exudate which may become purulent.

The author presents 2 cases and gives the following conclusions:

1. Postoperative pulmonary complications should suggest roentgen examination in the early stages.

2. Fusiform bacilli and spirochetes are the infective agents in this condition. Some authors believe previously devitalized tissue is necessary for their growth.

3. Clinically this simulates a bronchitis or bronchopneumonia, except that the sputum is always fetid.

4. Roentgenologically this resembles lung abscess or pulmonary gangrene, except that the lesion is likely to progress much more rapidly than is the case in the ordinary type of infection.

5. The accepted treatment for this condition is salvarsan in the earlier stages and operation in the later chronic stages.—*J. D. Camp.*

Duken, J. The roentgen examination of the thorax in tuberculosis of children. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1928, xxxviii, 1039–1054.

Duken accepts the theory of Ranke with regard to the cyclic course of all infectious diseases. This cyclic course can be observed also in syphilis and tuberculosis where three stages can be distinguished: primary, secondary and tertiary. For syphilis the three stages have become classical. In tuberculosis conditions are not so simple. The demarcation of the different stages is not so clear cut and the intermingling of manifestations of different stages is commonly seen. Roughly speaking, the primary stage begins with the time of contamination and lasts to the time of full development of the primary focus. The secondary stage comprehends the generalization of the disease beginning with the hematogen metastases and lasting till the appearance of the immunity process. The tertiary stage starts with the full development of the immunization. In contrast to the secondary stage the further dissemination here is by intracanalicular metastases and by direct contact. In adults a clear differentiation between the three stages is practically impossible. In children, especially in infants, the differentiation in certain cases is rather clear cut. Thus in scrofuloderma, for example, the primary stage is represented by the local manifestation of the disease. This sometimes is of a rather long duration. As soon as the tubercle bacilli enter the blood stream the second stage begins and then the organism responds to the irritation by an immunization process. Under the influence of this immunization a great variety of manifestations of the disease will appear. From this moment on the clinical picture often is highly complicated.

After a discussion of the general principles of pathogenesis Duken enters into the consideration of certain practical diagnostic points. First, there is the roentgenologic appearance of the primary lung focus. In most cases this primary focus is so small that it cannot be demonstrated by a roentgenogram and thus

it passes unobserved. Only later when calcification occurs is the focus visible in the roentgenogram. In rarer instances, the primary focus may be enlarged so that it can be demonstrated on the roentgenogram even in the acute stage. This enlargement as a rule is due to extension by continuity into the neighboring lung tissues; in such cases a breaking down of the tissues with cavity formation is not infrequent. It is well known that the primary focus is rather harmless. Practically always a healing occurs leaving a calcification as the only sign of a former involvement. Second, there is the differentiation between enlarged bronchial lymph nodes and enlarged thymic shadow. An enlarged thymic shadow sometimes can be so confusing that in one of Duken's cases a thoracoplasty was done on an assumed diagnosis of tuberculosis of the bronchial lymph nodes with cavitation. At the post-mortem examination it was found that the condition so diagnosed was nothing but an enlarged thymus gland. Therefore Duken advises that if all methods of differentiation have failed, a diagnostic pneumothorax be done, or still better, a therapeutic dose of roentgen rays be given. A treatment would produce a rapid decrease in the size of the enlarged thymus, while a pathological condition of the bronchial lymph nodes would remain uninfluenced, or at least show a very slow response. Third, Duken finally discusses the different changes observed at the roots of the lungs and within the lungs and insists especially on the value of the tuberculin reaction in ascertaining a positive diagnosis. All these points were demonstrated by lantern slides.—*T. Leucutia.*

DUNCKER, FR. Perforated fracture of a long bone produced by accident. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1928, xxxviii, 1123–1124.

An interesting case of a "hole-fracture" of the first phalanx of the left index finger following the accidental blow of a very sharp object is presented.—*T. Leucutia.*

EHRLICH. Circumscribed osteitis fibrosa of the skull. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 652–662.

A case of a circumscribed osteitis fibrosa of the skull is described in a man thirty-five years of age. Even in childhood there was an enlargement of the skull but this remained stationary until the patient reached the age of thirty. From then on the increase in the size of the skull was rather rapid.

The symptoms consisted in headaches, loss of memory, and later in paralysis of different cranial nerves (facial and acusticus), disturbance of vision, diplopia, exophthalmos, etc.

Roentgenologically the skull showed a marked thickening in the region of the parieta and temporal bones on the right side, with areas of rarefaction. Differential diagnosis includes sarcoma and syphilis. The importance of trauma in the case is not sufficiently clear. From a therapeutic standpoint the radical removal of the affected bone is advocated.—*T. Leucutia.*

FISCHMANN, MICHAEL. Contribution to peroral cholecystography. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 522–525.

The author calls attention to the fact that non-filling of the gall-bladder following cholecystography by the peroral method may be due also to a diseased condition of the pancreas. In 6 out of 42 cases examined the non-filling of the gall-bladder was the direct result of pancreatic lesions. In one of the cases following deep roentgen therapy for carcinoma of the head of the pancreas a filling of the gall-bladder was obtained two months following radiation therapy. This number is rather high considering that of the 42 cases there were only 8 cases with non-filling of the gall-bladder. The author therefore raises two questions: (1) How large a percentage of the non-filled gall-bladders following cholecystography is due to pancreatic lesions? (2) Would it be advisable for preventive reasons to add a pancreatic extract to the dye capsules?—*T. Leucutia.*

GEYMAN, MILTON J. Osteochondritis dissecans. *Radiology*, 1928, xi, 315–320.

The most commonly reported sites of this process are in the external condyle of the humerus and the lateral portion of the mesial condyle of the femur, the patella being mentioned in a few instances. It occurs chiefly in males of young adult age.

Barth regarded the condition, not as the result of a disease named osteochondritis dissecans by König, but as a pathological process definitely the result of trauma. The lack of a definitely traumatic history in many cases and the occasional occurrence of a bilateral case, has stimulated a great many theories to explain the characteristic separation of the fragments from a free articular surface. Freiberg believes that the occurrence of a long tubercle on the mesial tibial spine in a position of flexion and external rotation of the tibia or the femur results in a localized trauma to an arteriole in the mesial femoral condyle. Colvin believes that the production of a fibro-cartilage along the line of cleavage causes the fragment to bulge toward the joint and finally fracture,

the thin hyalin plate holding it in place. Bernstein believes that the process may be a constitutional disease involving the ends of long bones and that a hereditary factor is probably present.

The author presents 4 cases, the first involving the patella, the second involving the patella and external condyle of the tibia, the third the head of the femur, the fourth the external condyle of the humerus.

The following conclusions are given:

1. The occurrence of that type of loose joint body known as osteochondritis dissecans is not restricted to the knee and elbow joints. In the knee joint it may occur in sites other than the mesial femoral condyle, although this is the favored site.

2. The process is usually on a definitely traumatic basis.

3. The roentgen findings are uniformly typical, consisting of subarticular defects present in all cases, with or without visualization of the loosened fragment.—*J. D. Camp.*

Gotthardt, Paul Peter. Kymodensographic investigations on the heart. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1929, xxxix, 1–15.

Recent investigations of the author support the observations of Moritz and Dietlen that the normal heart decreases in size following forced exercise. This change in the size of the heart is independent of the type of exercise and depends only on the amount of the work done. Large hearts, as a rule, show a greater reduction in size than smaller hearts. The diminution in the size of the heart disappears within two hours following cessation of the exercise and then it shows an enlargement lasting for a period of thirty to thirty-six hours. After this period a status quo ensues. The pulse shows an acceleration while the blood pressure shows an increase of the systolic and decrease of the diastolic pressure. Within a quarter of an hour following the cessation of the exercise the amplitude of the pulse, which at the beginning was increased, shows a rapid decrease below normal and there is also some decrease in the systolic and a corresponding increase in the diastolic pressure.

The question arises whether or not the diminution in the size of the heart is a reactive process of the post-exercise period, or whether it already begins as a compensatory process during the period of the exercise itself. The author carried out numerous experiments (on 43 individuals) in order to elucidate this problem. Attention was paid especially to the width of the heart, to the volume of pulsation and to the amplitude of pulsation of the heart.

The changes in the width of the heart were studied by simple roentgenograms which were taken first in the rest period, second during the forced exercise period, and third, during the post-exercise period. In estimating the value of the width of the heart, the position of the diaphragm (especially of the left diaphragm) was taken into consideration and the necessary corrections made. It was found that the width of the heart during systole as well as during diastole shows a diminution during the period of actual exercise as compared to the period of rest.

The volume of pulsation of the heart was determined according to the Henderson-Haggard method by using the Grosse-Kaup modification. It was found that the volume of pulsation increases during the period of forced exercise, while in the post-exercise rest period this increase returns to normal value or becomes decreased. Thus there is an apparent discrepancy, in that the diminution in the width of the heart results in an increased volume of pulsation, indicating that the diminishing of the heart has as a consequence the expulsion of an increased quantity of blood during each pulsation.

The amplitude of pulsation of the heart was determined by the kymographic method. A bicycle ergometer was used for the measurement of the exact value of the forced exercise. Kymograms were made in the rest period previous to beginning the exercise (by letting the patient sit ten minutes in the bicycle ergometer so as to accommodate himself to the new conditions); seven minutes after the beginning of the forced exercise (after 3300 to 3800 meter kilogram actual work), and five minutes after the cessation of the exercise. The kymograms were taken by the slit kymogram cassette on duplitized films of 13 x 18 cm. size, 85 cm. skin target distance. The running time of the film was 2.4 sec., during which time the film moved over a distance of 10 cm. In analyzing the kymograms special attention was paid to the left border of the heart, that is to the pulsation of the left ventricle. It was found that the increase in the frequency of pulsation during the period of forced exercise appears on the kymogram as an increase of the left arc of the heart, with a subsequent decrease in the post-exercise rest period. The densographic measurements were also carried out both with iso- and denso-readings and this led to the same conclusion, namely, that the pulsation and the changes in density are confined mostly to the left border of the heart.

It was further found that the systolic and diastolic curves appear shortened during the period of forced exercise, there being not only

an increase in the frequency but also an accentuation of the pulsation wave manifesting itself chiefly in an abrupt drop of the systolic curve. This leads to a shortening in the excursion with an increase in the amplitude of pulsation. There is quite a dissension in the literature with regard to the value of the amplitude of pulsation, such a wide range of figures as from 1.5 mm. to 7 mm. being taken as normal by different authors. Gotthardt considers as normal 4.5 mm., and kymographic examinations showed that this value was increased with an average of 2 to 3 mm. during the period of forced exercise. Five minutes following the cessation of the exercise conditions returned to normal.

Proof is thus brought that the greater pulse volume of the heart during actual work cannot be ascribed to an increased diastolic esxpansion. The expulsion of an increased amount of blood during the actual work is the result of a change in the form of the heart leading to an increased amplitude of the pulsation—with elevation of the apex of the heart—with a corresponding decrease of the rest volume of the heart. The quicker relaxation of the heart due to the increased aortic pressure is probably the result of the quicker closing and better functioning of the valves, this again leading, because of the diminution of the back-flow, to a diminishing of the rest volume of the heart.

The slit kymograms give a more accurate registration of the phases of contraction of the marginal parts of the heart, while the surface kymograms give a better survey of the activity of the several sections of the heart, the elevation of the apex of the heart during the pulsation being especially well brought out. The densograms give information with regard to the excursions of the borders of the heart and they register the changes in form occurring near the borders. The registration of the changes within the heart proper is still the subject of investigation. Isograms may here be of decided value.—*T. Leucutia.*

GROSSMANN, J., and MELLER, OSKAR. A high displacement of the aorta to the right in a case of situs viscerum inversus subdiaphragmaticus showing a normal position of the heart. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1928, xxxviii, 1120–1122.

A case of situs inversus subdiaphragmaticus is presented in a woman fifty-five years of age showing no clinical symptoms and who had passed through nine normal pregnancies. The roentgenogram of the chest revealed a right-sided aortic arch with marked displacement to the right, the heart maintaining its normal position. The author discusses briefly the clinical as well as the roentgenological findings in the case and gives a short review of the malformations of the heart. The importance of the case lies in the presence of two developmental anomalies, namely, situs inversus subdiaphragmaticus and right-sided aortic arch.—*T. Leucutia.*

GRUDZINSKI, ZYGMUNT. On a new disease analogous to achondroplasia (chondrodystrophia): (osteochondropathia multiplex Grudzinski, achondroplasia atypica Silfverskiöld, dystrophie spongieuse epiphysaire systematisée Ghimus). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 873–882.

Achondroplasia may occur in a typical form such as described by Parrot and Marie and in an atypical or abortive form, which for a long time has formed a favorite topic for discussion. The atypical form, as a rule, is divided into three groups: (1) the partial or localized form which shows typical achondroplastic symptoms but with definite localization to certain parts of the body (peripheral, central, unilateral, shoulder form, etc.); (2) the abortive form (chondrohypoplasia of Ravenna), and (3) the clinical variants showing in addition to typical symptoms of achondroplasia such as dwarfism, micromelia rhizomelica, thickening of bone epiphyses, distortion of the diaphyses, isodactylia, etc., also symptoms characteristic of other developmental disturbances. Of the many skeletal diseases associated with achondroplasia are myxedema, mongolism, rickets, periosteal dysplasia, polydactylia, syndactylia, phocomelia, hypothyreosis, congenital subluxations, etc., further atrophic and degenerative forms of osteomalacia such as chondrodystrophia foetalis, dyschondroplasia, chondromatosis multiplex, etc.

Silfverskiöld in 1925 and 1926 reported 2 cases showing abortive symptoms of chondrodysplasia such as micromelia, shortening of the bones of the extremities especially of the fibula and of the hands and feet, associated with symptoms of osteochondritis deformans juvenilis or local malacia, consisting in destructive changes of the epiphyses of several long bones and resulting in deformities such as coxa vara, genu valgum, genu varum, pes varus, scoliosis, patella bipartita bilateralis and luxatio patellae bilateralis, etc. The condition was called by Silfverskiöld "achondroplasia atypica." The author describes a third case, expressing the opinion that the condition represents an entirely distinct entity for which he proposes the name of "osteochondropathia multiplex."

At the Second International Congress of Radiology Ghimus reported a fourth case with the localization of the dystrophic process mostly to the bones of the hands and he proposed the name of "dystrophie spongieuse epiphysaire systematisée."—*T. Leucutia.*

Hammer, Gerhard. The cardiac surface as a measure of the size of the heart. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1928, xxxviii, 1000–1015.

Hammer studied the relationship of the orthodiagraphically determined surface of the heart to the different standard measurements of the body. The observation was carried out on 100 subjects. The method of procedure was as follows: (1) The cardiac surface of the heart was measured planimetrically; (2) the value so obtained was brought in relationship to different standard body measurements and the average arithmetic value of the coefficient was calculated (coefficient = $\left(\frac{\text{cardiac surface area}}{\text{different body measuremts}}\right)$; (3) the average arithmetic value of the coefficient was brought up to 100 and the different values were expressed in plus or minus 100 (95 to 105 being considered as normal). The following body measurements were taken as standards: (1) height; (2) weight; (3) circumference of the chest; (4) different mathematically calculated "surface areas" such as thorax surface area which is a product of the longitudinal and transverse diameter of the thorax, etc.; (5) finally, the thorax volume and Bornhard's ideal weight.

The values for these factors were determined both by vertical and horizontal orthodiagraphy.

The following conclusions were reached: (1) There is a rather constant relationship between the planimetrically determined surface of the orthodiagram and the height, to the product of the height and circumference of the chest and especially the product of the height and the orthodiagraphically measured internal thoracic diameter. (2) In using body measurements which do not include the height as a factor as, for example, circumference of the chest, weight, different thoracic surface areas, etc., the relationship is less constant. (3) All relationships are more constant in the horizontal than in the vertical orthodiagram. (4) When the subject changes his position from the recumbent (horizontal) to the standing (vertical) the cardiac surface area diminishes 20 per cent or more. (5) The change in the cardiac surface area from the horizontal to the vertical position is especially pronounced in pathologically enlarged hearts. (6) In the evaluation of the size of the heart for practical purposes we may use in place of the planimetrically measured cardiac surface the "cardiac rectangle" which is the product of the longitudinal and transverse diameter of the heart. (7) The relationship of the cardiac area to height is not as constant as the relationship to the height-width product (height × orthodiagraphically measured thorax width). If height alone is used as the standard of comparison, tall subjects show an absolutely and relatively increased cardiac size. (8) There is no correlation between the cardiac surface area and the weight of the patient. In bringing in the weight factor as a standard, Bornhard's ideal weight should be used

$$\left(\frac{\text{height} \times \text{circumference of the chest}}{240}\right)$$

—*T. Leucutia.*

Heigl, R. Roentgen findings in joints of hemophiliacs. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1929, xxxix, 107–110.

The classification of joint lesions of hemophiliacs into (1) hemarthrosis, (2) panarthritis and (3) regressive stage, made by König in 1892 and by Vuillet in 1902 still holds good. On the basis of 11 cases studied, the author tried to arrive at certain criteria with regard to the roentgen characteristics of these lesions. However, he found that the differential diagnosis, especially from tuberculosis, is often very difficult, if not impossible. It seems that rounded zones with sharp contours observed in the bones of the joints affected are in favor of hemophilia and are probably due to intraosseous hemorrhage. Further observations are necessary in order to establish more certain criteria.—*T. Leucutia.*

Herrnheiser, Gustav. Temporary contraction or compression of the gall-bladder? *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 669–672.

Friedrich and Pflaumer recently described the following phenomena as characteristic of a tonic spasm of long duration in hypertrophy of the gall-bladder: (1) The diminution in size and angulation of the gall-bladder shadow in the sagittal view; (2) persistence of this form as well as persistence of the density of the shadow over a period of several hours (in one case ten hours; in another case four hours); (3) an entirely normal appearance of the gall-bladder at operation. In analyzing these phenomena the author thinks that the diminution in the size of the gall-bladder may be (*a*) organic, due to an atrophy of the gall-bladder wall; (*b*) functional, due to a more or

less permanent contraction of the gall-bladder, and (*c*) mechanical, due to extrinsic compression of the gall-bladder. The differentiation between a contraction and extrinsic compression therefore is very important. The following signs are considered more or less characteristic in the differentiation: (1) Since the extrinsic compression of the gall-bladder in the majority of the cases is in the direction of the transverse diameter (from right to left) the gall-bladder shadow appears small in the sagittal view but very large in the lateral view. The slight angulation of the gall-bladder in the lateral view is also of some diagnostic significance. (2) The contracted gall-bladder shows diminution in size in both sagittal and lateral views.—*T. Leucutia.*

Herzog, Arnold. Partial paralysis of the diaphragm. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* 1928, xxxviii, 518–522.

A total paralysis or relaxation of the diaphragm occurs more frequently than was formerly supposed. A partial paralysis of the diaphragm, however, is an exceptional occurrence. The author was able to find after a careful review of the literature only one case of partial paralysis of the diaphragm (Hitzenberger) which was due to a lesion pressing on the root of the phrenic nerve. Recently the author observed a second case where, however, the paralysis was due to a pressure on the phrenic nerve by a mediastinal tumor. It is most probable that the tumor produced a slight paresis of the phrenic nerve resulting in a loss of function of that portion of the diaphragm which is physiologically the weakest. The case was in a man fifty-seven years of age with a rapidly fatally terminating mediastinal tumor.

The most important signs of a partial paralysis of the diaphragm are the double dome, which is observed in all cases of relaxation of the median anterior diaphragmatic muscle, immobility or slight paradoxical respiratory movement of the affected portion of the diaphragm and arching of the dome of the diaphragm in sneezing during the Müller test. A differentiation between a true partial paralysis and a simple relaxation of the median portion of the diaphragm is impossible. —*T. Leucutia.*

Kaestle, Karl. The pneumoconiosis of sandstone, silica chalk, granite, limestone and cement workers. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* Dec., 1928, xxxviii, 1016–1034.

In a former article on procelain pneumoconiosis, Kaestle described the following three stages of pneumoconiosis: (1) multiple small densities disseminated over both lung areas with thickening of the trunk shadows leading towards the hilus but with no or only slight changes in the hilus itself; (2) multiple medium sized densities producing mottling with typical localization, enlargement and thickening of the hilus shadow and mediastinal lymph nodes; (3) massive dense shadows with typical localization intermingled with smaller shadows of stage 1 and 2, very marked thickening and increase in the shadow of the hilus. Patients in stage 3 were considered as total invalids.

In the present article Kaestle considers the pneumoconiosis of sandstone, silica chalk, granite, limestone and cement workers by using the same classification into the three stages and by paying especial attention to the chemical composition of the dusts of the above materials with regard to free silica. From this conclusions are drawn with regard to the importance of the free silica in the pathogenesis of pneumoconiosis.

The importance of free silica (SiO_2) in the production of pneumoconiosis was first stressed by English and American authors. As the result, indisputable evidence was brought by these authors that free silica is the factor responsible in connection with the pathological changes produced within the lungs and that the most dangerous dusts are the ones which contain the highest percentage of free silica.

The following observations were made by Kaestle with regard to this:

1. *Sandstone Workers.* Forty subjects from Untermain and 133 subjects from Middle Main were observed. The age incidence was as follows:

Years	Per cent
20–30	8.72
30–40	20.93
40–50	48.26
50–60	21.51
60–70	0.58

Thus over 50 per cent have passed the forty-five year period. The chemical composition of the sandstone was as follows: Crystal SiO_2, 80 per cent; Al_2O_3, 10 per cent and the rest ingredients. Of the first group of 40 subjects, 25 proved to be positive: 2 suffering from tuberculosis and pneumoconiosis and 23 from pneumoconiosis alone; one subject in stage 1, 13 in stage 2 and 9 in stage 3. Out of the 133 subjects in the second group, 38 were found to be positive, 3 suffering from tuberculosis and pneumoconiosis; 29 in stage 1 and 9 in stages 2 and 3. With regard to the pathological changes produced, it was noticed that the pneumoconiosis produced by sandstone

dusts has shown such a sharp margin and such an increase in the density of the shadows produced in roentgenograms that the picture somewhat resembles that of buckshot. The reason for this lies in the rather marked and local fibrosis of the area involved, in contrast to the changes produced by the "soft" or "colloidal" dusts where the areas are more diffuse due to surrounding interstitial fibrosis produced by the time factor.

2. *Silica Chalk (?) "Neuburger White."* Thirty-nine individuals were observed. The chemical composition of the silica chalk has shown 89 to 97 per cent SiO_2. The group observed here was constitutionally rather poor since most of the workers were invalids who could not obtain better jobs. Of the 39, eight were positive, one showing tuberculosis and pneumoconiosis and 7 showing pneumoconiosis alone; one in stage 1, 2 in stage 2 and 5 in stage 3. Here the pathological changes were similar to those observed in the pneumoconiosis of sandstone workers.

3. *Granite Workers.* Observed, 93 subjects. Age incidence, between fifteen and sixty years; 77.4 per cent more than thirty years old. The chemical composition of the granite has shown 30 per cent quartz. Of the 93 subjects observed, 64 were entirely well; 20 showed subjective symptoms but without positive findings and only 8 showed positive findings; 2 having tuberculosis and pneumoconiosis and only 6 pneumoconiosis alone, 4 in the first stage and 2 in the second stage. The surprisingly mild forms (only 6.45 per cent affected) are due to the low silica content of the granite.

4. *Limestone Workers.* Observed, 49 subjects. The limestones contain no SiO_2. Of the subjects only 7 showed enlargement of the hilus shadows but no lung findings and only 6 were considered as positive for pneumoconiosis; 4 in stage 1 and 2 in stage 2. Pathologically here the condition was different than in cases of sandstone workers. The spots were soft, more diffuse, without sharp limitation, showing in the roentgenogram so-called "soft," "fuzzy" shadows; also there was more involvement in the region of the hilus and in the central zones than the periphery of the lungs.

5. *Cement Workers.* The observation was made on workers with Portland cement: CaO, 62–65 per cent; SiO_2, 19–22 per cent; Al_2O_3, 7–9 per cent. Observed, 93 subjects: Of the 93 only 6 had positive roentgen findings; 4 in stage 1 and 2 in stage 2. Here also the changes were of the "soft," "fuzzy" character.

Summary. Thus evidence is brought that the aggressiveness of the pneumoconiosis depends primarily on the quantity of free silica (SiO_2). While all metal dusts are of more or less injurious effect the free silica is the most dangerous of all.—*T. Leucutia.*

KARLIN, M. I. On the question of the sella turcica in psoriatics. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 868–873.

The author undertook accurate measurements of the sella turcica in order to establish if there is any relationship between functional disturbance of the pituitary gland and psoriasis. Three methods were tried out: (1) the measurement of the length of the sella; (2) the measurement of the surface of the sella according to Haas, and (3) the planimetric measurement of the sella. Of the three methods the planimetric is the most correct; however, very accurate measurements of the sella turcica are not necessary when referring to functional disturbances of the pituitary gland since: (1) the size of the sella varies in normal individuals; (2) the measurements are only approximate, and (3) the changes in the size and shape of the sella do not indicate an abnormal condition of the pituitary gland.

The observations were carried out on 66 patients, 37 men and 29 women, the age varying between seven and sixty-six years, with the majority of the cases between twenty-one and forty years. It was found that in 10.5 per cent of all cases there was enlargement of the sella approaching the upper normal limit. In instances the hands were of acromegalic character. The possibility of a hyperfunction of the pituitary gland under the influence of functional disturbance of other glands or of the vegetative nervous system can in these instances of constitutional predisposition not be denied. An irradiation of the sella turcica may therefore lead to favorable results. Further investigations will be carried out with regard to this.—*T. Leucutia.*

KIRKLIN, B. R. A short summary of the present status of cholecystography. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 852–856.

During 1927, 5,705 cases were examined by cholecystography at The Mayo Clinic. Of these, in 1,967 (34.4 per cent) there was evidence of disease, while in 3,738 cases the findings were normal; 869 of the 1,967 diseased cases came to operation. In correlating the cholecystographic and operative findings, four groups are distinguished: (1) Lack of function of the gall-bladder with or without cholelithiasis—317 cases. In 243 (76.6 per cent) stones were found in a pathological gall-bladder; in 57 (18 per cent) there was no cholelithiasis but evidence of cholecystitis, and in 17 (5.4 per cent) there was a normal gall-bladder. Thus

the roentgen diagnosis was corroborated in 95 per cent of the cases at operation.

(2) Diminished function of the gall-bladder with or without cholelithiasis—212 cases. In 156 cases (73.6 per cent) there was evidence of cholecystitis and cholelithiasis; in 43 cases there was evidence of cholecystitis without cholelithiasis, and in 13 cases the gall-bladder was normal. Thus in this group the roentgen diagnosis was confirmed in 94 per cent of the cases.

(3) Normal function of the gall-bladder with cholelithiasis—9 cases. The roentgen diagnosis was confirmed in every instance.

(4) Normal function of the gall-bladder without cholelithiasis—331 cases. In 270 cases the gall-bladder proved normal at operation; in 47 cases there was evidence of a pathological condition and in 14 there was evidence of cholelithiasis. Thus the greatest error was made in the cases diagnosed as normal.

The author arrives at the following conclusions: Cholecystography has already proven to be an important diagnostic aid. The method of application has been perfected to such an extent that little can be expected in the future with regard to further improvement (except perhaps for the invention of some new contrast media and improvement in technique of exposure). Although cholecystography is an important diagnostic method it should be used only in conjunction with other clinical findings.—*T. Leucutia.*

Koppenstein, Ernst. Diverticula of the stomach. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 807–818.

Diverticula of the stomach are rare conditions, only a few being described by pathologists. From a detailed review of the roentgenologic literature the author was able to collect only 22 cases. Diverticula of the stomach may be functional or organic.

(1) *Functional Diverticula.* Several theories were advanced for the explanation of functional diverticula of the stomach. According to de Quervain, the condition is due to a partial paresis of the gastric wall, as a rule caused by an ulcerative involvement of a ramification of the vagus. Schlesinger, on the contrary, attributes the functional diverticula to tangenital spasms, while Åkerlund believes that most of the gastric diverticula observed are projections of duodenal or jejunal diverticula occurring in the region of the duodenojejunal flexure over the shadow of the barium-filled stomach. Hrabovszki recently was able to observe at operation the occurrence of a functional diverticulum of the stomach, thus proving beyond doubt the existence of such a condition.

(2) *Organic diverticula* of the stomach are congenital or acquired. Only one single case of acquired diverticulum of the stomach is known in the roentgen literature, that of Åkerlund. The author adds a second case. Congenital diverticula of the stomach have been diagnosed somewhat oftener. In the 22 cases collected from the literature, with the exception of the one acquired, all belong to this group. The author adds 3 new cases. In analyzing the symptomatology and the roentgen appearance of congenital diverticula, the author arrives at the conclusion that a revision of this classification is necessary. It was often found that mechanical influences (such as retraction, adhesions, etc.) played some importance in the mechanism of the congenital diverticula. Of the 3 cases described by the author, in one there was evidence of a duodenal ulcer, in the second, gall-bladder disease and in the third extensive adhesions, all factors which might have been responsible for the production of the diverticula.

Differential diagnosis includes ulcer, especially of the lesser curvature, and hernia of the esophageal hiatus in the case of gastric diverticula with localization to the cardiac end.

Therapy consists in conservative procedures and in cases where other diseases are evident, in the treatment of these diseases.—*T. Leucutia.*

Lehmkuhl, H. Contribution to the roentgenology of the child's heart. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 696–697.

Measurements were made with regard to the different diameters as well as of the surface and volume of the heart in the ages from one to fifteen years. The results were tabulated and it was found that, with the exception of the evaluation of the volume of the heart, the figures for different ages are fairly constant.—*T. Leucutia.*

Lemberg, A. A. Roentgen diagnosis of chronic joint diseases and their classification. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 818–833.

The following practical classification based on etiology is recommended:

1. Arthritis.
   1. Infectious secondary polyarthritis (cocci, rheumatism, grippe, scarlet fever).
   2. Typhoid.
   3. Tuberculous.

4. Luetic.

II. Arthroso-arthritis.
   1. Caused by disturbances of basal metabolism and chronic poisons (gout, hemogentisin, lead poisoning, etc.).
   2. Traumatic (so-called aseptic infections).
   3. Hemophilia.

III. Arthrosis.
   1. Angiotrophic (osteochondropathia juvenilis, angiosclerotica senilis).
   2. Neuropathic (tabetic, syringomyelic).
   3. Endocrinopathic (ovarial, thyreotoxic, pituitary, etc.).

IV. Neoplasms.
   1. Benign (osteoma, chondroma).
   2. Malignant (sarcoma).—*T. Leucutia.*

LINDBLOM, ADOLF F, Hydronephrosis caused by the pressure of a band of an aberrant renal vessel; roentgen diagnosis; operative verification. *Acta radiol.*, 1928, ix, 611–617.

A case of hydronephrosis due to pressure of a band containing an aberrant renal vessel over the lower renal pelvis is described in a patient twenty-nine years of age who for a period of over ten years had vague symptoms in the region of the affected kidney. In making a correct diagnosis it is necessary that a roentgenogram be taken also in the lateral view.

Although Crabtree described several pyelograms illustrating hydronephrosis produced by aberrant renal vessels, this is the first time that a lateral view has been used with great help in establishing a correct diagnosis. The case was verified at operation.—*T. Leucutia.*

LOBEN, FRANZ. A congenital dextrocardia with normal position of the abdominal organs. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 553–555.

A case of dextrocardia with normal position of the abdominal organs is described and in connection with this the frequency of lung complications is discussed. The case is that of a boy twenty-two years of age who developed tuberculosis of the lung and who was treated by the author. Although the tuberculosis apparently was arrested, because of the dextrocardia the prognosis is considered as unfavorable.—*T. Leucutia.*

LYON, ERNST. Calcareous nodules in the intervertebral discs. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1929, xxxix, 76–80.

The author describes a case in a woman thirty-five years of age who suffered from tuberculosis of the lung and who later, following an operation for carcinoma of the rectum, contracted during convalescence paratyphoid B. Because of the marked backache the patient had, roentgenograms were taken and there was evidence of calcareous nodules between the eighth, ninth, tenth and eleventh thoracic vertebrae. The author thinks that these nodules are the direct result of the infectious spondylitis (tuberculous or paratyphoid).—*T. Leucutia.*

MAYER, ERNST G. The roentgen findings in diseases of the nasal accessory sinuses. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1928, xxxviii, 1079–1101.

Mayer recommends that as a routine films in three different positions be taken in the roentgen examination of the nasal accessory sinuses: posteroanterior position, posteroanterior cranial excentric and axial. After describing the detailed technique for the above positions and discussing differential diagnostic points, Mayer makes the following summary with regard to the characteristics of the different conditions observed:

A. Acute empyema.
   1. Homogeneous, faint shadow.
   2. Homogeneous, dense shadow.
   3. Homogeneous shadow (slight or intensive) with bone erosion.
   4. Marginal shadow (a rare occurrence either in early stages or in stages of healing).

B. Chronic empyema.
   1. Dense, homogeneous shadow.
   2. Dense, homogeneous shadow with bone deposit.
   3. Dense (infrequently found), homogeneous shadow with bone erosion.
   4. Marginal shadow (of diagnostic interest only in case the sinus was drained shortly before and in the cases where the edematous mucous membrane does not fill the entire sinus).

C. Acute catarrhal inflammation.
   1. Homogeneous shadow, mostly of very slight intensity.
   2. Constant marginal shadow, mostly with slight haziness of the rest of the lumen.

D. Chronic catarrhal inflammation.
   1. Homogeneous shadow of slight intensity indicating retention of secretion due to insufficient ventilation of the sinus.
   2. Dense homogeneous shadow.
   3. More or less constant marginal shadow.

E. Vasomotor rhinitis.
   1. Homogeneous shadow mostly of slight intensity.
   2. Irregular marginal shadow.

F. Mucocele.
   1. Dense, homogeneous shadow.
   2. Dense, homogeneous shadow with regular bone erosion.

3. Slight, homogeneous shadow with regular bone erosion.
4. Regular bone erosion without shadow, eventually with displacement symptoms from the vaults.

G. Malignant tumors.
1. Dense, homogeneous shadow.
2. Marginal shadow.
3. Dense (rarely slight) homogeneous shadow with bone erosion.
4. Marked bone destruction.
5. Bone destruction and bone new formation.

H. Primary osteitis.
1. Hyperostosis and eburnization (idiopathic sclerosing hyperostosis).
2. Hyperostosis with sclerosing and foci of resorption (sclerosing form of Paget's disease).
3. Hyperostosis and osteoporosis (osteoporotic form of Paget's disease).

In practice the most satisfactory results are obtained in the roentgenologic examination of the maxillary antrum. The possibility of error here is the least. The differentiation of shadows caused by fluid or those caused by soft tissues is accomplished without difficulty; in some instances it is necessary to use the aid of a contrast medium. The ethmoidal cells are also readily outlined roentgenologically. The possibility of error is here also slight, although sometimes a differentiation between the presence of free fluid and soft tissues is not possible.

With regard to the frontal sinuses, the conditions are unsatisfactory. The possibility of error here is great because of great variation in the anatomical conditions. Also the differentiation of soft tissue density is often made with great difficulty especially when this is due to neoplasms. The filling of the ethmoids and frontals by contrast medium is a very difficult task and is of little practical value.

The demonstration of the sphenoidal sinuses is the most difficult. The error in diagnosis here is great. A filling of the sphenoidal sinuses by means of a contrast medium is accomplished easily but from a clinical standpoint such a procedure is not advisable.—*T. Leucutia.*

Moritz, F. The evaluation of the size of the heart. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* Dec., 1928, xxxviii, 993–999.

The clinical evaluation of the size of the heart by palpation and percussion is not sufficient. Teleroentgenography, teleroentgenoscopy and orthodiagraphy have more recently contributed a great deal to the study of the heart. The physiological errors produced by the pulsation of the heart and by change in position during the examination are more readily corrected by orthodiagraphy than by teleroentgenography. Also the apex of the heart can only be determined with difficulty in the films taken by teleroentgenography because the shadow of the apex fuses with the shadow of the diaphragm. For these reasons orthodiagraphy is the method of choice in the present day examination.

Orthodiagraphy can be done in both horizontal, or recumbent, and vertical, or standing, positions. It appears that the horizontal orthodiagraphy has certain advantages over vertical orthodiagraphy. These advantages are due to the fact that the horizontal silhouette of the heart shows less variation than would be the case with the vertical silhouette. This applies especially to the determination of the silhouette of the pathological heart. But there are also technical advantages in favor of the horizontal orthodiagraphy. Thus, first, the apex of the heart and the right cardiodiaphragmatic angle of the heart are both clearer in the horizontal orthodiagram than in the vertical orthodiagram. Another important advantage is the fact that the patient in recumbent position is kept absolutely still and therefore errors resulting from motion of the patient are eliminated.

In practice it is best to do an examination by using both the horizontal and the vertical orthodiagraphy.

Up until recently the transverse diameter of the heart was considered the most important factor in evauating the size of the heart. Moritz thinks that the planimetric determination of the heart silhouette is of far greater importance and has a greater actual value. However because of the difficult method of determining the heart silhouette planimetrically he advises a simpler method which consists in determining the surface area of the silhouette of the heart by the "heart rectangle" method. The procedure is as follows: The longitudinal diameter of the heart is plotted the usual way. Then at one end of the longitudinal diameter at a right angle the total value of the two transverse diameters is plotted obtaining thus a rectangle which is the product of its two dimensions, namely, of the longitudinal and the transverse diameter of the heart.

Moritz then compares the surface area of the heart determined by the heart rectangle to other standard measurements of the body such as height, weight and ideal body weight expressed by Bornhard's unit. A comparison of these measurements reveals that for practical purposes the most constant results are obtained in comparing the surface area of the heart to the product of the height and circumference

of the chest, or still better, to the Bornhard ideal weight (which is expressed by the product of the height and circumference of the chest divided by the constant 240). Moritz has worked out a coefficient which in 15 normal cases has given the average value of 20.1. In order to simplify things, 20.1 was considered equal to 100, thus all values being expressed in relationship to 100. The minimum value in normal cases was taken as 86 and the maximum value as 112. In pathological cases the variation was between 112 and 180.

In conclusion, the author proposes that in order to evaluate the size of the heart the coefficient of the cardiac surface (cardiac rectangle) be expressed by the product of the height and thoracic transverse diameter. Due to the fact that the Bornhard ideal weight is only two dimensional, it is proposed that whenever possible the cardiac surface area be expressed also in relationship to Bornhard's ideal weight.—*T. Leucutia.*

Popovic, L., and Smokvina, Milan. Contribution to hysterosalpingography—extrauterine pregnancy, hematocele. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 834–841.

The three cardinal signs pointing to pregnancy (whether this be intra- or extrauterine) are: (1) the enlargement of the uterus with atony and irritability to various stimuli; (2) slight deviation of the uterus to the right or to the left. This deviation is especially marked in hematocele, while in pure extrauterine pregnancy it may be absent; (3) the reaction of the musculature to hypophysin (Höchst). Every uterus reacts to hypophysin but the reaction of the pregnant uterus is prompt and more intensive.

In addition to these signs which often are only of relative value, the author emphasizes in extrauterine pregnancy the following hysterosalpingographic signs: (*a*) Functional signs: (1) there is delayed filling of the tube or, in some instances, complete lack of filling; (2) the filling of the tube occurs in a spastic, rhythmic manner thus leading to abrupt interruptions in the continuity of the outline of the contrast shadow, these interruptions showing an annular shape; (3) less frequently, there is an angulation of the tube.

(*b*) Direct signs: (1) there is a defect due to the implantation of the ovum, and (2) in some instances, there is a picture resembling "ruptured bladder." This sign, first described by the authors, is observed in cases with perforation of the membrane where the contrast medium diffuses in all directions, also entering the blood vessels and extending into the abdominal cavity in a manner similar to that observed in a ruptured bladder following the injection of an excess amount of contrast medium.

The author found 23 cases of extrauterine pregnancy out of 350 cases in which hysterosalpingography was employed.—*T. Leucutia.*

Popovic, L. Pregnancy; A contribution to hysterosalpingography. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 842–845.

In analyzing the value of hysterosalpingography in the diagnosis of pregnancies of from four to six weeks' duration the author found that the signs obtained by hysterosalpingography are practically the same whether the pregnancy is continuing normally or whether there is a missed or incomplete abortion.

(1) The functional signs are the more or less symmetrical enlargement of the uterus with atony and a marked hypophysin (Höchst) reaction.

(2) The direct signs are defect in the filling of the uterine cavity due to the implantation of the ovum in cases of normal pregnancy and a picture resembling that of the ruptured bladder in missed or incomplete pregnancy. In this latter, after the filling of the uterine cavity the contrast solution diffuses in all directions, enters the blood vessels and also distributes itself in the abdominal cavity. The appearance in serial roentgenograms changes rapidly showing the picture of a conglomeration of patches without any structural arrangement.—*T. Leucutia.*

Pribram, B. O. Experiences on the diagnostic value of cholecystography. *Acta radiol.*, 1928, ix, 582–591.

The author discusses the errors resulting from faulty technique and from a misinterpretation of the findings on roentgen films in cholecystography.

With regard to the technique, the most important point is the use of a proper contrast medium. The author experimented with different contrast media administered both intravenously and by the oral method and more recently found that the intravenous administration of iodoatophane (3 gm.) has very great advantages. Further experiments will be carried out with regard to the peroral administration of this preparation. A second important point is the emptying of the gall-bladder preliminary to the administration of the contrast medium, which is done by the injection of hypophysin. Since the optimum filling of the gall-bladder shows great variations it is recommended that several roentgenograms be taken at different intervals. In case of spastic tendencies, espe-

cially in ulcers and in tardy evacuation of the gall-bladder, the administration of atropine is advocated.

In analyzing the errors resulting from a faulty interpretation of the films, the author finds that most of the errors are committed in the gall-bladders with good filling. Several examples are cited in order to prove that it is erroneous to assume that every gall-bladder showing a good filling represents an absolutely normal condition. In case of a faint shadow one should avoid assuming an incomplete filling of the gall-bladder. A very important problem in cholecystography is the demonstration of the occlusion of the cystic duct since most of the fatal complications in gall-bladder disease (necrosis, perforation, peritonitis, cholangitis, sepsis) are secondary to the occlusion of the cystic duct. The author believes that by a very careful technique and by a cautious interpretation of the roentgen films an occlusion of the cystic duct can be demonstrated in a great number of cases.—*T. Leucutia.*

Regnier, E. Multiple diverticula of the small intestine. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* Dec., 1928, xxxviii, 1101–1104.

The anatomical as well as the clinical and roentgenological symptoms are discussed in diverticula of the small intestine. A case is presented where a roentgenological diagnosis of diverticulosis was made. At post mortem over 100 diverticula were found which on histological examination proved to be true diverticula. Since true diverticula were demonstrated in such a great number, this may be considered as a very rare case.—*T. Leucutia.*

Rietema, L. P., and Keijser, S. Calcinosis intervertebralis. *Acta radiol.,* 1928, ix, 606–610.

Two cases of calcinosis intervertebralis (in patients fifty-two and fifty-one years of age) are described. The condition is discussed with regard to differential diagnosis from spondylitis.—*T. Leucutia.*

Roseno, Alfred. Pneumoroentgenography in urologic differential diagnosis. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* Dec., 1928, xxxviii, 1105–1110.

A description is given of the technique, dangers and indications of pneumoroentgenography as practised according to Rosenstein's method. The author stresses the importance from the point of view of differential diagnosis in cases of renal and vesical tumors. A case of renal dystopia and of a large vesical papilloma is demonstrated and in the light of the findings the importance of pneumoroentgenography in such cases is emphasized.—*T. Leucutia.*

Rosselet, A. Contribution to the study of aerocoly. *Acta radiol.,* 1928, ix, 546–551.

The author describes the mechanism of the displacement of the stomach due to aerocoly. It appears that the action of aerocoly is the consequence of three pressures corresponding to the different positions of the colon. These pressures are: (*a*) a pressure from left to right which is roughly perpendicular to the great curvature; (*b*) a pressure which is anteroposterior, and (*c*) a pressure which is in the posteroanterior direction. The different displacements of the stomach during the different phases of the examination are the result of the summation of these three pressure effects. Their knowledge is important from the point of view of differential diagnosis since a displacement of the stomach due to aerocoly may be erroneously diagnosed as a pathological condition.—*T. Leucutia.*

Schertlein, A. The most frequent anomalies in connection with the twelfth dorsal and first lumbar vertebrae. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* 1928, xxxviii, 478–488.

The anatomical variations and anomalies of the cervicodorsal and lumbosacral transitional regions are well known, but no attention has been paid heretofore to the disturbances occurring in the dorsolumbar transitional region. In studying the roentgen appearance of 1000 routine spines, an abnormality was discovered in 72 of the cases of which 62 were in men and 10 in women. In 55 cases the anomaly was bilateral and symmetrical; in 17 cases it was localized to only one side. The disturbance as observed on the first lumbar vertebra could be classified into three groups: In the first group there is a simple separation of the transverse process; in the second group there is a rib-like formation, and in the third group there is a true rudimentary accessory rib. The disturbance observed on the twelfth dorsal vertebra is that described as a lumbarization of the vertebra and manifesting itself in enlargement of the vertebral body, in a lumbar configuration of the transverse process and a visibility of the intervertebral space.—*T. Leucutia.*

Schnek, Fritz. Unusual localization of traumatic myositis ossificans. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* Jan., 1929, xxxix, 81–87.

The author describes several cases where myositis ossificans occurred in the neighborhood of joints as a result of luxations or

fractures. The cases mentioned show myositis ossificans in the muscles of the elbow, shoulder and hip joints. It is most probable that the calcareous deposits resulted following hematoma due to the injury. It is a well-known fact that foreign body giant cells appear in hemorrhagic areas and it is probable that these giant cells lead to bone new formation resulting in calcareous deposits such as are observed in myositis ossificans.—*T. Leucutia.*

Schultze, Günter K. F. Hysterosalpingography (indication of its practical diagnostic usefulness). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1928, xxxviii, 1073–1078.

In injecting the pelvic organs with iodized oil, Schultze distinguishes four phases characterized as follows: The first phase represents the filling of the uterus by pressure. The injected oil first fills the upper part of the fundus by taking a gradually oval and finally a triangular shape. In the second phase the oil enters the tubes. This is due to the contraction of the uterus and not to pressure. In the third phase the oil enters the ampulla due to the contraction within the tube itself. In the fourth phase the oil enters the abdominal cavity. Some time elapses between the entry of the oil from the tube into the abdominal cavity which is very important from a differential diagnostic standpoint.

One may observe filling defects in the first phase due to partial filling, poor distribution of the oil within the uterine cavity and to pathological conditions. The second phase may be disturbed by technical causes such as insufficient pressure or insufficient quantity of oil injected or by physiological causes such as poor contraction of the uterus and by pathological causes such as occlusion of the uterine ostium of the tubes. The same applies to the third and fourth stages where the disturbance may be produced either by insufficient pressure, insufficient quantity of injected oil or by pathologic-anatomical changes. These changes necessitate the introduction of a standard technique which should take into consideration the following factors: (1) A complete filling of the uterus is necessary, and should be roentgenoscopically controlled; (2) the quantity of the oil injected must correspond to the size of the uterine cavity and the tonus of the uterus should be especially taken into consideration; (3) serial roentgenograms should be taken in order to observe the changes in motility; (4) because of the importance of the time elapsing between the third and fourth phases, roentgenograms should be taken the day following or several days later. Only by working out a standard technique can hysterosalpingography be made a really practical method of examination.—*T. Leucutia.*

Shutschenko, B. Differential roentgen diagnosis of myeloma and bone carcinoma. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 509–514.

Three cases (one myeloma and 2 metastatic carcinoma) are described, and the differential diagnosis from the roentgenologic appearance is discussed briefly. The only positive sign for myeloma is the more rounded, sharper delineation of the osteolytic areas as compared to the destruction produced by the metastatic carcinoma foci. The only certain criterion, however, is the localization of the primary lesion.—*T. Leucutia.*

Stewart, W. H., and Illick, H. E. A plea for the standardization of technic in the oral method of cholecystography. *Radiology*, 1928, xi, 271–280.

The authors present a summary of the literature and the results following the examination of 600 cases using the oral method. Four hundred ninety, or 91⅔ per cent, showed a gall-bladder shadow, and 110, or 18⅓ per cent, were "no shadow" cases. Of these 110, twenty-seven were operated on, and in every case pathology was found. Of the 600 cases, 40 showed gallstones without the dye and an additional 40 with the dye. The total number of cases reported as pathological with or without stones reached 327. Sixty-nine of these were operated on, and in 67 definite gall-bladder pathology was found.

The dose of tetraiodophenolphthalein is computed individually and given in plain gelatine capsules transferred from the ampule a few hours before administration. The dye is thus fresh, unexposed to light and air, and not subject to deterioration. The use of the pure fresh drug is insisted upon, and the authors believe that it is one thing that has kept their percentage of reactions low and their percentage of gall-bladder shadows high.

The authors are convinced that most of the dye is absorbed through the gastric mucosa, and from experimental research have found that a certain percentage of the soluble salt administered is converted into an insoluble form by the hydrochloric acid of the gastric juice, but there still remains sufficient of the soluble salt to be absorbed by the mucosa and to render the bile opaque. To prevent this reaction bicarbonate of soda is administered with the dye, and both are given when the acidity of the gastric contents is the lowest.

In making a roentgenographic examination of the gall-bladder by the oral method the

following technique is recommended. The gastrointestinal tract should be thoroughly cleansed by a mild cathartic, administered the night before the first examination. This preliminary examination of the gall-bladder before administration of the dye is best made in the afternoon. While it is going on, the 3.5 gm. tetraiodo, the contents of one sealed colored glass ampule in which it is dispensed, is transferred into eight plain gelatine capsules. These capsules, including four 10-grain capsules of bicarbonate of soda, are given to the patient with the following written directions: "At 6 P.M. eat a meal consisting of soup, creamed chicken, or soft boiled eggs, vegetables, bread and butter, and a glass of milk. Commencing at 9:30 P.M., take two capsules of the tetraiodo and one capsule of the bicarbonate of soda with a half-glass of water every fifteen minutes until all the capsules have been taken." The following morning the patient is to have no breakfast and is directed to report at the doctor's office at 9:30 A.M. At this time the 12-hour examination is made. Starvation is continued and four hours later the 16-hour examination is performed. Lunch is then allowed, consisting of two soft boiled eggs, two pieces of well buttered toast, and a cup of tea. An hour later the 18-hour examination follows. An evening meal is permitted and the patient is told to report the following morning for the final observation, the 36-hour examination. After this, barium is given and the stomach and duodenal bulb, as well as the hepatic flexure, are studied for evidence of adhesions or associated lesions.

Having established a definite, accepted technique for gall-bladder examination, it is necessary to define what is meant by a gall-bladder with a normal function as we see it cholecystographically. The essentials are proper filling as seen twelve hours after the dye; proper concentration as noted four hours later; proper emptying, partial or complete, following a lunch, and a complete disappearance of the shadow thirty-six hours after the administration of the dye.

As compared with the above negative findings, the positive cholecystographic indications of disease of the gall-bladder are, in the order of their importance, as follows: (1) Cholelithiasis; (2) failure to visualize the gall-bladder; (3) deformity of the gall-bladder shadow; (4) faintness of shadow; (5) persistency of the shadow, and (6) late appearance of the shadow.—*J. D. Camp.*

USPENSKY, A. The roentgen diagnosis of diseases of the right dome of the diaphragm. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 845–852.

Eventration of the right dome of the diaphragm is a very exceptional occurrence. There are two types of eventration of the right dome of the diaphragm: (1) the congenital form due to disease of the diaphragm itself, and (2) the acquired form due to disease of the adjacent organs (pericolitis, phrenicopleuritis).

The clinical symptoms of the eventration may be divided into four groups: (1) pulmonary symptoms; (2) cardiac symptoms; (3) gastrointestinal symptoms, and (4) mixed symptoms. Differential diagnosis includes diaphragmatic pleuritis, subphrenic abscess, tumor of the right upper quadrant (echinococcus cyst of the liver, hypernephroma, etc.). In case of partial eventration of the right dome of the diaphragm, differential diagnosis from hernia is often impossible.—*T. Leucutia.*

V. FALKENHAUSEN, FRHR. The roentgen diagnosis of luetic aortitis of the lower portion of the thoracic aorta. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 672–674.

The author describes a case of syphilitic aortitis in a patient seventy-four years of age where the lesion was localized to the lower portion of the thoracic aorta. The roentgen examination first revealed an enlargement of the mediastinal shadow while the administration of a barium mixture showed displacement of the esophagus corresponding to the region of the lower portion of the mediastinal shadow with tortuosity. There was a marked compression with distortion of the esophagus; there were no signs of dysphagia.—*T. Leucutia.*

WEBER, G. The importance of examination of the thorax in the lateral view in children, especially for the demonstration of pseudoperihilar shadows. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 662–669.

The roentgen examination of the chest in the lateral view in children is especially important in cases of differentiation between true perihilar and pseudoperihilar shadows. Pseudoperihilar shadows are, in the author's estimation, areas of pulmonary consolidation and interlobar pleuritis when they appear near the roots of the lungs, or in the perihilar region. An anteroposterior view in many of these instances would be insufficient to make a correct diagnosis, while a lateral view often gives more accurate information. It is also possible to recognize by means of a lateral film whether or not a hilar tuberculosis is localized to the mediastinal tissues or to the lymph nodes at the bifurcations of the large bronchi.—*T. Leucutia.*

WERTHEIMER, ROBERT. Cholesteatoma of the skull. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 656–662.

A case of cholesteatoma of the skull in a patient thirty-eight years of age is reported, the condition being discovered accidentally during ventriculography. The tumor was localized to the region of the right frontal extending over to the parietal and to the ala of the sphenoidal bone. There was rarefaction of the bones involved with a rather sharp spherical outline. The roentgen appearance was that of a benign tumor. With regard to the differential diagnosis the possibility of glioma, endothelioma and cystic tumors (echinococcus, cholesteatoma, angioma, cystic gliomas) was considered but no accurate diagnosis could be made. The tumor was successfully removed by operation and the histological report was that of cholesteatoma. The lesion is rare, only a few cases having been described in the literature.—*T. Leucutia.*

Zehbe, Max. On ulcer of the canalis egestorius (prepyloric ulcer). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 461–478.

In describing the roentgen appearance of gastric ulcers, it is customary to differentiate between ulcers of the corpus, of the pylorus and of the duodenal bulb. Schinz and Herrnheiser were the first a few years ago to separate a fourth variety, showing more or less typical roentgen signs, the ulcer of the egestoric canal or the prepyloric ulcer.

The author analyzing the findings in 691 cases of gastric ulcer found that 37 of them, that is, 5.4 per cent, were prepyloric ulcers. This percentage coincides with that of Schinz who in 66 cases found 6 per cent prepyloric ulcers. The figure of Herrnheiser is somewhat higher (12 per cent), but he also included some ulcers which were on the borderline of the pylorus.

The roentgen signs observed in prepyloric ulcer are either organic or functional. The organic signs are the niche, the barium patch, the hour-glass formation of the greater and the scar retraction of the lesser curvature, etc. The functional signs are pyloric insufficiency, hour-glass formation, tenderness over the prepyloric region, and in about 84 per cent of the cases observed, spastic contraction of the prepyloric region. In 60 per cent of the cases analyzed a positive diagnosis could be made on the basis of the organic signs; in 40 per cent of the cases no organic signs could be detected. A probable diagnosis, however, was made in the majority of the cases from the functional signs.

Special emphasis is laid on the multiplicity of the ulcers in the prepyloric region. In 6 of the 37 cases several ulcers (in one four ulcers) were present within the prepyloric region; in 3 further cases a second ulcer was detected in the duodenal region and in 3 cases on the lesser curvature of the stomach.

The author concludes that although the prepyloric ulcer is etiologically and anatomicopathologically similar to other ulcers observed within the stomach, because of the characteristic roentgen appearance it should be classified as a separate entity.—*T. Leucutia.*

Zeitlin, A. On small aortic aneurysms not recognizable roentgenologically. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 514–518.

Four cases of aneurysm of the aortic arch (2 on the concave and 2 on the convex side) are described in which roentgen examination was of no value. On post-mortem examination it was found that the aneurysms were in the region of the left bronchus and trachea so that the superimposition of these structures produced confusion in the interpretation of the roentgen findings. All patients complained of marked shortness of breath; therefore the author advises that in the absence of other findings the possibility of a small aneurysm of the aortic arch be considered in all such cases.—*T. Leucutia.*

Zoelch, Philipp. Contribution to the diagnosis and treatment of thymic hyperplasia. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1929, xxxix, 18–23.

Two cases are described (one in a child six months and the second in a child fifteen months of age) showing on the roentgenograms of the chest a rounded shadow apparently connected with the structure of the heart, in which a diagnosis of congenital lesion of the heart was made. In the first instance, the application of roentgen therapy led to disappearance of the shadow, while in the second case the pathological shadow disappeared spontaneously within four weeks following the examination. It is thought that in both cases the roentgen rays (in the first instance applied as a therapeutic, in the second as a diagnostic agent) produced a regression of the lesion thus aiding in the correct diagnosis.—*T. Leucutia.*

ROENTGEN AND RADIUM THERAPY

Béclère, Antoine. The radiation therapy of brain tumors. *Strahlentherapie*, 1928, xxxi, 42–87; *J. de radiol. et d'électrol.*, April, 1929, xiii, 209–232.

From the point of view of localization of intracranial tumors, the skull may be divided into two cavities: (1) the fossa hypophyseos, and (2) the brain cavity proper.

(1) Tumors of the fossa hypophyseos. According to Cushing, the tumors of the fossa hypophyseos represent 20 per cent of all intracranial tumors. More than 80 per cent of these tumors have their origin in the anterior lobe of the pituitary gland, being true adenomas ((*a*) chromophobe adenomas with hyperpituitarism, 50 per cent; (*b*) chromophile adenomas with acromegaly, 28 per cent; (*c*) cystic adenomas with hypopituitarism, 17 per cent, and (*d*) malignant adenomas with invasive tendency and hypopituitarism, 5 per cent), the other 20 per cent representing tumors of the diverticulum of Rathke or suprasellar tumors, or finally, extrasellar tumors from tissues near the fossa hypophyseos. A differential diagnosis of the true adenomas from tumors of the diverticulum of Rathke or of the other tumors in the neighborhood of the hypophyseos is important because of the different method of treatment.

(2) Tumors of the brain cavity proper. The most frequent of these tumors are the gliomas which originate from the cerebral and cerebellar tissues and which represent 41.7 per cent of all the intracranial tumors. Tumors of the intracranial nerves (such as neuroma, neurinomas and peripheral gliomas of the nervus acusticus) occur in 8.6 per cent, while tumors of the meninges, formerly called endotheliomas but now following the suggestion of Cushing called meningiomas, represent 11.4 per cent. The rest of the tumors are congenital tumors (tumors of the diverticulum of Rathke, epidermoid and dermoid cysts and teratomas); granulomas (tuberculosis, syphilis) metastatic tumors, papillomas, angiomas and unclassified tumors. From the therapeutic standpoint the most important group are the gliomas. These formed the topic of a recent article by Bailey, Sosman and Van Dessel (AM. J. ROENTGENOL. & RAD. THERAPY, March, 1928, xix, 203–264) who on the basis of microscopic examinations tried to correlate the radiosensitivity of the various glioma groups. Ten microscopic subvarieties were described, the average life duration in the different subvarieties ranging from ten months to seven years. The ones with the shortest average life duration (medulloblastoma with 15 months' average life duration, multiforme spongioblastoma with 12 months' average life duration, and astroblastoma with 28 months' average life duration) are the most radiosensitive while the ones with longest average life duration (protoplasmic astrocytoma with an average life duration of 67 months and fibrillary astrocytoma with an average life duration of 86 months) are the least radiosensitive. The other histological subvarieties occupy an intermediate position. According to Bailey, Sosman and Van Dessel, irradiation of gliomas should be attempted only after surgical procedures (removal or decompression) since all that can be expected from radiation therapy is an arrest of the lesion with consequent prolongation of life. Nevertheless one can find many cases described in the literature where radiation therapy was applied primarily without even decompression, with very satisfactory results both with regard to improvement in the symptomatology and reduction in the intracranial pressure.

(3) The mode of action of the irradiation. The primary action is no doubt on the tumor cells. Since there is no proof that the tumor cells are entirely destroyed one may surmise—from the clinical results observed—that an inhibiting effect on the growth of the cells is produced. In addition to this there is a secondary action through a diminution of the cerebrospinal fluid brought about by the effect of the roentgen rays on the choroid plexus, this resulting in a lessening of the intracranial pressure.

(4) Disadvantages and dangers of roentgen therapy. (*a*) Injury to the normal brain tissue. Although repeated animal experiments have shown proof that the brain tissue is very resistant to radiation, an intensive irradiation, especially when repeated often and with very penetrating rays, may lead—through secondary tissue reaction—to deleterious effects. (*b*) Reactions to treatment. These may be prereactive, observed within a few hours following the treatment and lasting for a period of one to two days, and true roentgen reactions beginning ten to fourteen days following the treatment and lasting for a period of several weeks. The prereaction, which is produced by hyperemia and edematous swelling of the irradiated tissues, manifests itself clinically in headaches, nausea, vomiting, visual disturbance, paresis, and occasionally in spasmodic contractions, and depends on the amount of the dose applied as well as on the degree of intracranial pressure already present at the time of the irradiation. The true irradiation reaction is the same as for other tissues.

(5) Indications for treatment. From the point of view of the method of treatment to be applied it is wise to divide the intracranial tumors into three groups: (*a*) The pituitary tumors. In the true adenomas roentgen therapy is the method of choice and the results obtained are the better, the sooner the treatment is given. Only the cases not responding to irradiation should be submitted to operation (trephination of the fossa hypophyseos by the transphenoidal route), the continuation of irradiation following operation, however, being

advisable. The tumors of the diverticulum of Rathke as well as the supra- and extrasellar tumors are refractory to irradiation and therefore operative procedures should be attempted primarily. (*b*) The suspected but not definitely localized tumors. Here also radiation therapy should be attempted first. If following the irradiation conditions should turn worse a decompression is indicated, this again to be followed by further irradiation. Of course in view of the lack of knowledge with regard to the type and location of the lesion such a procedure can be of only palliative value. (*c*) The surgically extirpated tumors. Neuromas and meningiomas as a rule are easily extirpated. Radiation therapy because of the great radioresistance of these tumors is here of no value. In the gliomas an operation is only seldom complete. In the majority of the cases either an incomplete removal of the tumor or only a biopsy can be performed. All gliomas should be irradiated postoperatively.

(6) Technique of irradiation. As a general rule, hard penetrating rays should be used. Because of the danger of prereaction the treatment should be started with small doses first by administering 500 R (French) per sitting over one field of entry. If the treatment is well borne the dose can be increased [illegible]00 R per sitting. The total dose per field is 3500 R which should not be repeated sooner than within two to three months. The following detailed technique is advisable for the various groups: (*a*) pituitary adenomas: 120 to 150 kv., 0.5 mm. Cu plus 1 mm. Al, 23 cm. skin target distance, 4 ports of entry (2 frontal and 2 temporal), one or two sittings per week, each sitting consisting of an irradiation through two ports of entry with 500 R. The series consists of ten to twelve sittings repeated for the second time with an interval of two months; for the third time with an interval of three months; (*b*) suspected but not definitely localized tumors: 180 to 200 kv., 1 mm. Cu plus 1 mm. Al as filters, 30 to 50 cm. skin target distance, large fields, the number of portals of entry depending on the localization of the tumor. Following a first irradiation with 500 R, 1000 R is given at intervals of twenty-four to forty-eight hours, total dose per field 3500 R; depth dose on the site of the tumor or on the choroid plexus 3000 to 4000 R which is administered within a period of two to three weeks; (*c*) surgically extirpated tumors: the same technique is applied as for (*b*) with the exception that a depth dose of 4000 R is given; also the total dose per field is reduced to 1000 to 2000 R and treatment is repeated at two to three months' intervals for several series. An extensive bibliography is appended.—*T. Leucutia.*

Desjardins, Arthur U. Radiotherapy in actinomycosis. *Radiology*, 1928, xi, 321–330.

Approximately 30 proved cases of intra-abdominal or intrathoracic actinomycosis were observed at the Mayo Clinic between 1920 and 1925. Nineteen of the patients were males, and 10 were females. The average age of the males was thirty-four and a half years, with extremes of fourteen and fifty-five years. The average age of the females was twenty-nine and one-tenth years.

In 26 cases the disease affected chiefly the intestinal or pelvic structures or both. The pulmonary apparatus or thoracic structures were the principal seat of the disease in 11 cases, and in 7 the lesions were in both the thorax and the abdomen.

The treatment in most cases consisted of a combination of drainage, the administration of iodides internally, and roentgen irradiation of the abdomen or thorax. Radium treatment was also given in 8 cases at some time during the subsequent course of the disease. In 11 cases drainage or any other surgical intervention was not required.

If the lesion was situated in the abdomen, roentgen rays were applied from the level of the xiphoid cartilage to that of the lower border of the pubis, generally through four anterior and four posterior fields. The rays were always generated at about 135 peak kv., the focal skin distance usually was 16 in., and the intensity of the current flowing through the Universal Coolidge tube was 5 ma. Each of the anterior abdominal fields was treated with the rays filtered through 4 mm. Al, and the posterior fields with rays filtered through 6 mm. Al. Such a course was repeated several times at intervals of three or four weeks; or, if the patients could not return to the Clinic for such treatment, they were instructed to arrange for it with a roentgenologist near their home. Improvement was not always immediate and sometimes distinct improvement was not noted until after the second or third course of treatment. Unfortunately, many patients were so ill and the lesions were so extensive when the treatment was started that the termination must necessarily be fatal. In other instances, the patients, for various reasons, failed to follow instructions.

It is probable that drainage alone or in conjunction with the use of iodides may have influenced the subsequent improvement of some of the patients; but, in view of the well-known influence of irradiation on actinomycotic

processes, it is likely that the chief factor in the improvement noted in some of these cases must be credited to irradiation.

The author gives the following conclusions: Many cases have been reported to show that roentgen rays are a potent therapeutic agent against *Actinomyces* in lesions of actinomycosis. The earlier and the more superficial the lesions, the more rapidly they are made to involute and disappear by exposure to roentgen rays.

Actinomycotic lesions around the head and neck can nearly always be eradicated by thorough irradiation, by drainage of purulent collections, and by the internal use of increasing daily doses of sodium or potassium iodide; irradiation is undoubtedly the chief factor in the cure.

When actinomycosis attacks the intestine or the lungs, the disease often becomes extensive before its true character is recognized. Irradiation in such cases is seldom successful in effecting a cure, but slight or great improvement is not uncommon. Better results could undoubtedly be obtained if the diagnosis were made and the treatment instituted earlier.—*J. D. Camp.*

GÁL, FELIX. A surprising improvement with small roentgen doses in cases of carcinoma of the uterus considered hopeless. *Strahlentherapie*, 1928, xxxi, 91–96.

Three cases of extensive carcinomata of the uterus are described where at first massive irradiation was applied with temporary improvement. Following a relapse, the patients reached a very critical stage and irradiation with small doses (½ S.U.D.) was applied merely for psychic reasons. Surprisingly there was a remarkable improvement in all cases following this mild irradiation lasting for a period of several years.—*T. Leucutia.*

GAMBAROW, G. Thirteen years' experience in radiation therapy in uterine carcinoma. *Strahlentherapie*, 1928, xxx, 467–470.

About 500 cases were treated between 1914 and 1923 by the application of radium by using 50 mg. radium element in Dominici tubes, intrauterinely for twelve to fourteen hours, the treatment being repeated for five to seven applications at one to two day intervals, for the total dose of from 3000 to 4900 mg-hr. One hundred and four of these cases were followed up and there was a five year healing in only 5.7 per cent.—*T. Leucutia.*

GILBERT, RENÉ. The treatment of malignant granulomatosis with deep roentgen therapy. *Acta radiol.*, 1928, ix, 552–581.

The material includes 25 cases (23 verified microscopically) of Hodgkin's disease treated systematically since 1922. The cases are placed into two groups: those treated systematically (15) and those who had only partial treatment (10). Of the cases treated systematically 8 cases are alive from one to five years and 7 died. All cases who have received incomplete treatment have died.

It is advocated that the treatment be carried out with very penetrating roentgen rays and that it be extended also to regions which have not shown involvement as yet but which are known as a frequent site of the process. The results obtained by such a procedure are superior to those obtained by irradiation with rays of longer wave length and more local application.—*T. Leucutia.*

GOETTE, K. Injury following irradiation in Basedow's disease. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1929, xxxix, 111–113.

Two cases of Basedow's disease are described which following irradiation with a small dose (in one case ¼ S.U.D., in the other case two sittings of 1/10 S.U.D.) showed rapid increase in the toxic symptoms, with death. It is the author's contention that radiation therapy is not without risk in the treatment of Basedow's disease.—*T. Leucutia.*

GROEDEL, FRANZ M. The treatment of climacteric manifestations by means of roentgen irradiations of the ovaries. *Strahlentherapie*, 1928, xxxi, 142–146.

It has been repeatedly advised that stimulative irradiation be given over the pituitary and thyroid glands in cases with severe climacteric manifestations. The author has tried the irradiation of the ovary with very mild doses and in 1922 reported the results obtained in 15 cases. Since that time numerous other cases have been irradiated, with satisfactory results. The author therefore believes that in all cases of climacteric changes with prolonged severe symptomatology, an irradiation of the ovaries should be attempted. It will remain for the future to determine the most suitable dose. Only in cases where an irradiation of the ovaries fails to produce noticeable results should an irradiation of the pituitary or thyroid gland be carried out.—*T. Leucutia.*

HEUCK, W., and VONKENNEL, J. Thallium or roentgen epilation of mycosis of the scalp? Therapeutic comparison and clinical observations. *Strahlentherapie*, 1928, xxxi, 181–198.

Following the procedure of Buschke the author used thallium aceticum purissimum Kahlbaum for epilation purposes in children

up to fifteen years of age. The thallium was administered in a single dose, in sugared water on an empty stomach. According to the amount of thallium given the patients treated were divided into different groups. Of the 73 cases treated, 51 received thallium powder and 22 thallium tablets. Of the cases treated with thallium powder 15 received 8 mg. per kilogram of body weight; 30, 9 mg., and 5, 10 mg. (one case received 6 mg. twice at eight-day intervals). Of the 22 cases given thallium tablets, 6 received 8 mg. per kilogram of body weight, and 16, 9 mg.

Following the administration of the thallium a local disinfection of the scalp was started by applying the first day 10 per cent tincture of iodine twice daily; the second, third and fourth days, 10 per cent sulfur zinc salve twice daily; the fifth day 25 per cent essence of pyrogallol twice daily; the sixth day 5 per cent salicylic vaseline, and the seventh day a hair wash and clinical control. This cycle was repeated five to six times. Epilation began, as a rule, on the seventh day and within sixteen to eighteen days was complete. Of the 73 cases treated good epilation was obtained in 50 per cent and in the other 50 per cent the epilation was only partial. A recurrence of the disease followed in 24 per cent of the epilated cases. Thus, in comparing the results with epilation by roentgen therapy there can be no doubt that the latter is superior. The method of Mayer (five fields, dosage according to Sabouraud 9 x, with 0.5 mm. Al, which is equal to 65 per cent of a full dose) is the ideal method for roentgen epilation. A complete epilation is reached in 100 per cent of the cases and there is a recurrence of the disease in only 3.4 per cent.—*T. Leucutia.*

Holfelder, Hans. Our experiences on 25 cases of bone sarcomas treated by deep roentgen therapy. *Strahlentherapie*, 1928, xxxi, 33–41.

Twenty-five cases of bone sarcoma were treated by deep roentgen therapy during the period 1920/21–1925/26, sixteen of which were observed for a period of three years and 9 for a period of two years following completion of the treatment. Of the 16 cases observed for a period of three years, 10 died, and 6 were cured. Of the 9 cases observed for a period of two years, 2 died and 7 remained well. Of the total of 13 cases who have remained well, 5 were giant cell tumors and 8 osteogenic sarcomas.

The dose applied was as follows: 90 to 120 per cent S.U.D., administered in one sitting at the site of the bone tumor; saturation of the dose four to eight days later according to Pfahler's method, occasionally a second and third saturation being done. After a rest of two to four months, the treatment was repeated. It is interesting that the treatment has to be extended over a long period to obtain complete results. Especially is this true of the giant cell tumors where treatment sometimes extends over a period of a year. Of course with subsequent irradiations, the dose is gradually reduced. The conclusion is reached that all bone sarcomas should be irradiated first and only the cases refractory to irradiation should be submitted to operation.—*T. Leucutia.*

Ipatoff, K. W., and Romanowa-Leskowa, A. A. Roentgen therapy of multiple disseminated sclerosis. *Strahlentherapie*, 1928, xxxi, 164–177.

Forty cases of disseminated sclerosis were treated with roentgen therapy by using the following technique: 10 to 25 per cent S.U.D., on the surface of the skin, with 140 kv., 4 mm. Al as filter, three ports of entry for the skull, one for the cervical, two for the dorsal and one for the lumbar spine. The series thus consisted of seven sittings, given at one to two weeks' intervals. Three to four weeks were allowed between the series. The treatment in most instances was carried out over a long period, sometimes as long as one year. More recently, the brain has been irradiated through five ports of entry by using 10 per cent S.U.D. over each portal.

Twenty-eight of the 40 cases treated were followed up; 22 of these showed marked improvement and in 4 cases there was a clinical healing.

The authors believe therefore that roentgen therapy is the treatment of choice in multiple disseminated sclerosis. An improvement follows in a majority of the cases and in instances there is clinical healing.—*T. Leucutia.*

Käding, Kurt. The roentgen therapy of chronic arthritis. *Strahlentherapie*, 1928, xxxi, 135–141.

Roentgen therapy is of considerable value in the different forms of arthritis. In chronic arthritis the application of roentgen therapy is local. In the affections of the joints due to endocrine disturbances, an irradiation of the pituitary gland or ovaries by means of stimulative doses is indicated. In cases of purpura rheumatica as well as in certain tuberculous affections of the joints an irradiation of the spleen is of considerable value. Some truly remarkable results were obtained in gonorrheal infections of the joints. In gout the irradiation should be carried out only in the chronic forms. In all instances it should be irradiated with very mild doses (150 to 180 kv., 4 ma., 5

mm. Al or 0.5 mm. Cu plus 1 mm. Al as filters, 27 to 35 cm. skin target distance, 15 to 35 per cent S.U.D. surface dose). It is advised that in all cases of arthritis where other methods of treatment have failed, irradiation should be tried.—*T. Leucutia.*

KAMNIKER, H., and ST. SIMON. Radiation therapy of infections of the female adnexa. *Strablentberapie*, 1928, xxx, 441–466.

The material includes 81 cases divided into the following groups: (1) gonorrheal adnexitis—19 cases; (2) post-partum and post-abortum adnexitis—27 cases; (3) adnexitis of unknown etiology—21 cases; (4) post-partum and post-abortum parametritis—12 cases, and (5) perimetritis—2 cases. With regard to the doses applied and the results obtained therefrom the cases were divided into four groups: those receiving a surface dose of (1) 10 per cent S.U.D. (73 per cent results); (2) 15 per cent S.U.D. (57 per cent results); (3) 20 per cent S.U.D. (63 per cent results), and (4) 45 per cent S.U.D. (52 per cent results). Thus best results were obtained with the smallest doses. Under "results" is understood the clinical improvement whether of a permanent or only temporary nature. A permanent healing was obtained in only 13 cases, representing mostly puerperal adnexitis or adnexitis of unknown etiology. In none of the cases of gonorrheal adnexitis was there a permanent healing.—*T. Leucutia.*

KAPLAN, A. L. On the question of ovarian irradiation and the effect on the offspring. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 556–565.

Three cases of irradiation of the ovaries are described, with subsequent pregnancies and full term deliveries. One of the cases was that of chronic endometritis where irradiation was given shortly before the conception. The second cases was that of a congenital atrophy of the uterus and dysfunction of the ovaries where stimulative irradiation was applied over the ovaries, and shortly after termination of the radiation therapy conception ensued. The third case was that of a myeloid leucemia where irradiation was given during the course of the pregnancy. In the first two instances the babies were entirely normal; in the third case, because of the serious condition of the patient, a craniotomy had to be performed. However post-mortem examination of the baby revealed no evidence of degenerative changes.

The cases are cited as proof that a normal course of the pregnancy with a normal development of the fetus may take place after direct irradiation of the ovary, a phenomenon which lately has aroused considerable discussion, especially as the result of the animal experiments of Nürnberger and Dryoff who claim that an ovum irradiated following conception could never show a normal development, an interruption of the pregnancy occurring as a rule.

The author also discusses the relationship between pregnancy and myeloid leucemia, as well as the question of transmission of the leucemia from mother to infant. Although pregnancy is considered as a rare occurrence in leucemic patients, in instances similar to the one mentioned by the author the pregnancy may go to full term. The leucemia, however, is not transmitted to the infant.—*T. Leucutia.*

KAPLAN, A. L. Roentgen therapy of climacteric changes. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 565–568.

Twenty-five cases of "climacteric changes" were irradiated over the pituitary gland because of the very severe character of the menopause symptoms such as vasomotor disturbances (hot flashes, headaches, sleeplessness, pruritus, dermatitis), psychic disturbances, etc. Of the 25 cases treated 5 were cases with normal climacterium, 12 with artificial menopause produced by roentgen rays for treatment of myomas and 8 with artificial menopause produced by oöphorectomy.

The irradiation was as follows: Neo-Intensiv apparatus (in 8 cases Heliopan), Coolidge tube, 180 kv., 4 ma., 0.5 mm. Zn plus 1 mm. Al, 25 cm. skin target distance, field 5 × 5 cm., 6 H per field, one to two irradiations with one week interval.

Remarkable results were obtained in 22 cases; in 3 cases there was no result. The author therefore thinks that irradiation of the pituitary gland should be undertaken in all cases of climacteric changes showing a severe symptomatology.—*T. Leucutia.*

KRAUSE, PAUL. The roentgen therapy of leucemic priapism. *Strablentberapie*, 1928, xxxi, 125–134.

Two cases of myelogenous leucemia are described, with priapism of long duration where the priapism was relieved following the application of roentgen therapy. In connection with this the different causes leading to priapism are discussed.—*T. Leucutia.*

KUMER, L., and SALLMANN, L. The discoloration of the iris following radium therapy. *Arch. Opbth., Berl.*, 1927, cxxi, 238–240.

Forty-one children treated with radium for angiomas of the eye were observed with regard to the discoloration of the iris produced by the radium. It was found that the majority of the

children with brown iris showed an intensification of the color following the application of radium. In children with gray, blue or light irises a discoloration was observed only exceptionally. These cases were then compared with control children who had more or less similar angiomas around the eye but who did not receive any treatment. They also were compared with normal children having no angiomas. It was found that in none of the control children was there any discoloration of the iris.

It is noteworthy that no other changes were observed in the eyes of the children following radium application; especially was there no disturbance of any kind with regard to the normal development of the eye.

In another series the author investigated changes produced in adults receiving radium therapy around the eye. It was found that in 5 cases out of 18 there was a similar discoloration of the iris (3 times in brown, once in blue and once in dark grey iris).

In children the radium treatment was carried on for one-half to one and a half years with a dose from 1 to 5 S.U.D. gamma radiation by using the fractional divided method at two to three week intervals. In only one case was there a small dose (½ S.U.D.) applied.

The author arrives at the conclusion that the discoloration of the iris is the result of changes of pigment deposit. This explains the fact that brown irises are especially predisposed.—*T. Leucutia.*

Lahm, Wilhelm. The permanent healing of uterine carcinoma following radium and combined radium and roentgen therapy. *Strablentberapie*, 1928, xxx, 471–489.

The material includes 469 cases treated between 1915 and 1923; 345 of these being treated by radium alone and 124 with a combination of radium and roentgen therapy. The following results were obtained for the different clinical stages: In the cases treated with radium alone, five year cures; in Stage I, in 37.8 per cent; Stage II, in 25 per cent; in Stage III, in 13.3 per cent, and Stage IV in 3 per cent, the average percentage being 19.4. In the cases with a combined treatment of radium and roentgen rays, in Stage I there were 50 per cent cures; in Stage II, 48.7 per cent; in Stage III, 25.3 per cent, and in Stage IV, 0 per cent, the average percentage amounting to 33.8. The procedure in the cases treated by radium alone was as follows: 50 to 75 mg., in some instances 100 mg., radium element was applied for a total of from 6000 to 10,000 mg-hr., which was given over a period of from three to five weeks. In the combination of radium and roentgen therapy the amount of radium was 5000 to 7000 mg-hr., and the amount of roentgen radiation from 400 to 1000 R, given over the same period. In analyzing the inhomogeneity of the irradiated field the author paid especial attention to the following zones which he calls the critical zones: (*a*) the cervical parametrial margin (1.5 cm. distant from the cervical canal); (*b*) the region of the ureters and rectum (2.5 cm. distant from the cervical canal), and (*c*) the region of the pelvic lymph nodes (6 cm. from the cervical canal). By applying a radiation of 1000 mg-hr. in the cervical canal the following amount reaches the different zones: (*a*) 415; (*b*) 115, and (*c*) 25, which makes a ratio of 16:6:1. In the combination of roentgen rays and radium this ratio is reduced to 4:2:1, which is considered as the optimum ratio. This fact explains why the results obtained by a combination of radium and roentgen rays are superior to the results obtained by radium alone.—*T. Leucutia.*

Lerche, William. Hodgkin's disease of the neck and mediastinum. *Arch. Surg.*, Jan., 1929, xviii, 329–338.

The author reports an interesting case of Hodgkin's disease, occurring in a woman aged twenty-four, who has been living for eighteen years since she first consulted him. During that time she has had bilateral cervical operations and a mediastinotomy. Following the last two operations, roentgen therapy was given. Lerche attributes the good result to operation.
—*E. P. Pendergrass.*

Levy, Robert L., and Golden, Ross. The treatment of rheumatic carditis by roentgen irradiation of the heart. *Am. Heart J.*, December, 1928, iv, 127–144.

Thirty patients with rheumatic heart disease have been treated by roentgen irradiation over the cardiac area. The machine setting was 200 kv. peak, 50 cm. target skin distance, 4 ma., and 0.5 mm. copper + 1.0 mm. aluminum filter. Ten per cent of the theoretical erythema dose was distributed throughout the heart area by irradiating both a front and a back field. A course of four such treatments was given with two weeks between sittings, followed by a rest period of one or more months.

The patients have been observed from a few months to three years. At the end of the follow-up period 21 of the 30 cases showed improvement. Three were temporarily improved, one was unimproved and 5 died. Electrocardiographic changes following irradiation, and believed to be the effect of it, were observed in 17 out of the 30 cases. In 5 of 7 patients with

paroxysms of severe heart pain, relief followed roentgen therapy. Teleroentgenograms disclosed no changes in heart size which could be ascribed to the effects of irradiation.

Slight roentgen sickness was observed in 14 cases. In no instance was there evidence of injury to the heart or of an unfavorable effect on the course of the disease.

Four cases of bacterial endocarditis were uninfluenced by irradiation of the heart.

Early cases, in the first attack of rheumatic fever, offer the best chance for success in therapy. In a number of cases with low-grade infection, predominantly cardiac, it appeared that the infection subsided following roentgen therapy. Those patients did better who received more prolonged treatment.

It is suggested that roentgen irradiation of the heart in rheumatic fever may desensitize the tissues of the heart to an allergizing substance, thereby favoring the subsidence of existing lesions and preventing further cardiac damage.—*R. Golden.*

Lipowitz, N. S., and Salzmann, G. G. Roentgen therapy in trachoma. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 359–363.

The material includes 44 cases treated by roentgen therapy using the following technique: 1 to 1.5 ma., hardness 8 to 9 Wehnelt, dose 5 to 6 x (measured by Holzknecht-Sabouraud), interval between treatments two to three weeks, total number of treatments two, or more rarely three. The following conclusions are reached: (1) Roentgen treatment results in improvement of the trachomatous process and the time of healing is shortened. (2) The method is of special value in children. (3) It is possible that more energetic doses would result in still more favorable results; however, no experiments have been carried out as yet with regard to this. (4) The effect of the irradiation is not directly on the virus but is rather through the stimulation of healing processes. (5) Radiation therapy should be combined with the usual treatment methods such as irradiation of the conjunctiva and the application of disinfecting salves.—*T. Leucutia.*

Magnus, Hans. Roentgen irradiations of pituitary tumors, with remarks on hemianopic immobility of the pupil. *Arch. Opbth., Berl.*, 1928, cxxi, 225–237.

The author collected 34 cases of pituitary tumors, 4 with acromegaly, one with dystrophia adiposa genitalis, 4 with hypogenitalism, 4 with adiposity and 21 without any other disturbance, and analyzed the improvement produced in the vision as well as in the visual field by the different methods of treatment. Twenty-two of these cases were treated by irradiation, 5 by operation, 3 by opotherapy (iodine and hypophysin) and 4 were left untreated.

Of the 3 cases treated by opotherapy, one remained stationary and 2 showed no improvement. Of the 5 operated cases, 2 died as a result of operation, one showed no improvement in the general symptomatology and in the fifth the eye not affected was saved.

Of the 22 cases treated by irradiation, in 11 there was marked improvement, these representing 50 per cent of the irradiated cases and 32 per cent of the total cases. The technique of irradiation was as follows: 80 per cent S.U.D. was applied five times through four portals of entry (two temporal, one frontal and one occipitoparietal). The improvement occurred, both in the vision and in the visual field, and was especially pronounced in the cases with acromegaly. It is well known that acromegaly is due to a benign eosinophile adenoma of the anterior lobe of the pituitary gland which as a rule is highly radiosensitive. In the other cases tumors of different classification (cysts, carcinomas, endotheliomas, etc.) were present and consequently the results were according to the radiosensitiveness of the tumors.

The author calls attention to the immobility of the temporal portion of the pupil which was observed in 3 cases with amaurotic eyes. No satisfactory explanation of this could be given and nothing was found in the literature to account for it.—*T. Leucutia.*

Nahmmacher, F. The combined treatment in mammary carcinoma. *Strahlentherapie*, 1928, xxx, 490–496.

The author advises the following procedure regardless of the classification in the treatment of mammary carcinoma: (1) preoperative roentgen irradiation (intensive irradiation) of the entire anterior thorax, axilla, as well as supra- and infraclavicular regions on the involved side; (2) fourteen days following roentgen therapy, radical operation; (3) four weeks following the operation, postoperative irradiation of the axilla as well as the supra- and infraclavicular regions with radium; in extensive cases the radium treatment to be extended also to the entire left anterior thorax.

If necessary four to five weeks later radium treatment should be repeated.

Since the method has been used for only one year no opinion can be expressed with regard to the results obtained.—*T. Leucutia.*

Palugyay, Josef. On the technique of roentgen therapy of lesions of surgical tuberculosis. *Strablentherapie*, 1928, xxx, 397–440.

In analyzing the results obtained by radiation therapy in lesions of surgical tuberculosis one finds that the small doses lead to the best therapeutic effects. The author gives a very detailed review of all statistics which he was able to collect in the literature proving this fact. According to the amount of radiation given by the different authors the results obtained (in the treatment of tuberculous lymphoma and bone and joint conditions) are classified in four groups: (1) a surface dose not exceeding 50 per cent S.U.D. with slight penetration, and the percentage depth dose below 15 per cent S.U.D.; results in lymphoma, 42 per cent; in bone and joint conditions, 41 per cent; (2) a surface dose exceeding 50 per cent S.U.D. with high penetration and the percentage depth dose at least 15 per cent S.U.D.; results in lymphoma, 52 per cent; bone and joint conditions, 49 per cent; (3) a surface dose not exceeding 50 per cent S.U.D. with high penetration and at least 15 per cent depth dose; results in lymphoma, 62 per cent; bone and joint conditions 62 per cent; (4) a surface dose below 50 per cent S.U.D. with slight penetration and a depth dose below 15 per cent S.U.D.; results, lymphoma, 78 per cent; bone and joint conditions, 69 per cent. Thus it is evident that the best results were obtained by the irradiation with small doses (below 50 per cent S.U.D.) and small penetration.

In attempting to explain this peculiar response of the tuberculous lesions toward irradiation one has to take into consideration certain well-known experimental facts; thus, there is no direct effect of the roentgen rays on the tubercle bacilli nor is there an indirect effect by means of autolytic or other decomposing processes (such as decomposition into lecithin or cholin). It is most probable that the action on the tuberculous process is secondary through tissue reactions, such as destruction of lymphocytes and leucocytes, stimulation of connective tissue formation and a general immunizing effect.

Thus it being established that the small doses with lighter penetration give the best results, the author undertook a number of experiments in order to determine the smallest dose which would still be therapeutically efficient. This he did by carefully observing the reactive processes produced by different doses such as elevation of temperature, local swelling, increased pain, increased discharge, etc. From an analysis of 360 patients he arrived at the conclusion that by applying rays of 180 kv. maximum, with 0.5 mm. Zn and 1 mm. Al filters, from a focus skin target distance of 23 to 30 cm. a surface dose as small as 5 per cent S.U.D., and a dose on the lesion as low as from 1 to 5 per cent S.U.D. was still therapeutically efficient. By applying this minimum dose, treatments can be repeated at one to two weeks intervals, depending on the amount of the reaction produced. It is best to carry out the irradiation until the completion of the series which as a rule comprises three to six treatments. Between the series other therapeutic methods such as tuberculin therapy, heliotherapy, iodine application, etc., can be used. It is however advised against a combination of these methods with the radiation therapy since they may lead to undesirable reactive processes. The following procedure is advised for different conditions: (1) Tuberculous lymphadenitis: 5 to 10 per cent S.U.D. surface dose repeated at ten to fourteen days' intervals. In chronic cases the dose is slightly larger; in fistula formation it may represent even 20 to 30 per cent S.U.D. (2) Bone and joint conditions: It is best to start with slight irradiation and then gradually increase the doses until a slight reaction is produced. Sometimes a dose as low as 1 to 2 per cent S.U.D. is applied and this is gradually increased to 10 to 15 per cent S.U.D. In the chronic cases the doses are somewhat larger. (3) Tuberculosis of the tendon sheaths and synovial membranes: 5 to 10 per cent surface dose is given at seven to fourteen days' intervals. (4) Tuberculous peritonitis: The abdomen is divided into four to eight ports of entry and a dose of 5 to 10 per cent, later 20 per cent, S.U.D. surface dose is given alternately at intervals of seven to fourteen days. (5) Ileocecal tuberculosis: The results are often remarkable. Here the doses are somewhat larger and more penetrating radiation is used. However 10 to 15 per cent S.U.D. on the lesion should not be exceeded. (6) Tuberculosis of the kidneys, ureters and bladder: Penetrating radiation with 20 per cent S.U.D. surface dose and 5 to 10 per cent on the lesion is applied. The treatment is given through three ports of entry, alternating at seven to fourteen days' intervals. (7) Genital tuberculosis in men: Four ports of entry are used, one abdominal, one perineal and two scrotal (one anterior, one posterior); abdominal perineal fields 10 × 10 cm., scrotal fields 5 × 5 cm., penetrating rays with 5 to 10 per cent surface dose on the abdominal and perineal fields and 1 to 5 per cent surface dose on the scrotal fields. Treatment is repeated alternately at intervals of seven to fourteen days.

The author includes the statistics of his own

cases showing some truly remarkable results. A very extensive bibliography on the subject is appended.—*T. Leucutia.*

SCHENDEROW, L., and KOPELMANN, S. The roentgen therapy of acromegaly. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 641–652.

Eleven cases of acromegaly treated by roentgen therapy are reported, the observation following the treatment being six to three and a third years. The method of treatment was as follows: Neo-Intensiv apparatus, 185 kv. (165 kv. eff.), 4 ma., 24 cm. skin target distance, 0.5 mm. Zn plus 1 mm. Al as filters; large Metro tube, 1 S.U.D. (= 12 H = 560 R with Wulf ionization chamber), depth dose 21 per cent; one to two frontal and two temporal ports of entry of 5 × 5 cm., 1 S.U.D. per field (½ S.U.D. per sitting), total six to eight sittings with intervals of one to two days.

Excellent results were obtained in 3 cases and in 7 cases there was marked improvement (disappearance of headaches, improvement of both vision and visual field); the acromegalic symptoms themselves did not disappear.

The conclusion is reached that roentgen therapy is the treatment of choice in acromegaly, being preferred to surgery since this latter carries a high percentage of mortality. Only the cases refractory to roentgen therapy should be reserved for surgery.—*T. Leucutia.*

SCHNEIDER, GEORG HEINRICH. Roentgen therapy of purpura hemorrhagica. *Strahlentherapie*, 1928, xxx, 503–505.

A case of purpura hemorrhagica is described which at the time of menstruation showed exacerbation of symptoms. The case was that of a constitutional rheumatoid peliosis menstrualis in a patient thirty years of age. An intensive irradiation of the spleen with a dose of 30 per cent S.U.D. produced only temporary improvement. An exovulation done later led to amenorrhea and thus to permanent healing. —*T. Leucutia.*

SIELMANN, RICHARD. A new field for roentgen therapy of diseases of the thyroid. *Strahlentherapie*, 1928, xxxi, 117–124.

Based on an experience of 1200 cases over a period of twenty years, the author believes that in cases of disease of the thyroid gland various hormones are secreted manifesting an effect on multiple organs. The following observations were made with regard to different diseases in which such a hormone effect depending on the secretion of the thyroid is probable: (1) Skin—scleroderma and psoriasis. In both conditions an irradiation of the thyroid and thymic glands with 50 to 70 per cent S.U.D. often leads to improvement. (2) Respiratory organs—occasional cases of bronchial asthma and the so-called latent hyperthyroidism of Pordes in incipient apical tuberculosis, in both instances irradiation of the thyroid being of curative effect. (3) Heart and circulatory system—tachycardia, organic heart lesions and hyperthyroidism following excessive iodine medication. With the exception of the iodine hyperthyroidism, the results obtained by the irradiation of the thyroid gland in this group are of a milder degree. (4) Gastrointestinal tract—diarrheas (in 30 per cent of the thyroid cases) and stomach disturbances (8 to 10 per cent) manifesting themselves in anacidity or hyperacidity. These symptoms are also relieved by irradiation over the thyroid gland. In all instances irradiation should be carried out with very mild doses.—*T. Leucutia.*

VON WIESER, WOLFGANG FREIHERR. An attempt at roentgen therapy in psychiatric and neurologic diseases in children. *Strahlentherapie*, 1928, xxxi, 147–163.

In 1923 the first attempt was made to treat the irritability of mentally deficient children by application of mild irradiation over the brain tissue. Not only were the results obtained satisfactory but it was soon discovered that other symptoms also improved following the irradiation. Therefore the author started to apply roentgen therapy as a regular procedure for the control of different symptoms of psychiatric and neurologic patients and different groups were devised according to the extent of the treatment applied.

The irradiation over the brain was first carried out through two small fields of 4 × 4 cm., from 25 cm. skin target distance by administering 30 per cent S.U.D.; later the fields were increased to 6 × 8 cm., with 30 cm. skin target distance. In cases with endocrine disturbances the treatment was extended also to the thyroid and thymic glands by giving a dose of from 10 to 20 per cent S.U.D. In cases with neurologic localization the treatment was extended over the entire spine by using three ports of entry, 6 cm. wide and 10 to 18 cm. long, and administering a dose of 5 to 20 per cent S.U.D. In mongoloids an irradiation of the entire body with 1 to 2 per cent S.U.D. was carried out successfully. As a conclusion it is advised that roentgen therapy be introduced as a systematic treatment in various psychiatric and neurologic conditions, the irradiation being carried out with very mild doses.—*T. Leucutia.*

Ward, George Gray. Radium therapy of carcinoma uteri. *Am. J. Obst. & Gynec.*, Jan., 1929, xvii, 1–13.

This is a review of the experience in radium therapy of carcinoma of the uterus at the Woman's Hospital during the last ten years. It is stated that there are probably 300,000 persons suffering with cancer in the United States at the present time, with an estimated death rate of 69.4 per 100,000.

The author discusses a paper presented before the Scandinavian Surgical Society in June, 1927, by Heyman, which he considers the outstanding contribution to recent literature on this subject. In this essay, Heyman omits all doubtful statistics, does not deduct intercurrent deaths and untraced cases, and quotes only five-year cures. The figures he cites may be summarized as follows: Cures for total cases by operative treatment approximately 18 per cent, by radiological treatment 16.3 per cent, cures for operable and borderline cases by operative treatment, 35.6 per cent, by radiological treatment 34.9 per cent. Primary mortality of operative treatment 17.2 per cent, of radiological treatment approximately 2 per cent; 43 per cent of the cases treated surgically were really operable, and only 30 per cent of those treated radiologically; this fact makes comparison of results difficult.

From 1914–1921, Forssell and Heyman reported from the Radiumhemmet at Stockholm 22.4 per cent of 502 cases treated radiologically as five-year cures, the operability percentage here being 29.1 per cent. Of 145 operable and borderline cases 44.4 per cent showed a five-year cure.

The Woman's Hospital in 1925 reported two series of irradiated cases with 23.6 per cent of five-year cures for all cases, and 52.9 per cent for operable and borderline cases.

The present report is based on cases treated from 1919 up to and including the first five months of 1923. One hundred and thirty-four were cases of primary carcinoma of the cervix treated by irradiation alone; 23.1 per cent of all cases reported show five-year cures, and 53.1 per cent of the operable cases.

Ward urges that, in reporting results of radium therapy, five essential factors be observed; (1) uniform classification of the extent of the disease; the terms "early" and "advanced" are preferable to the more elastic "operable" and "inoperable;" (2) five-year results of all treated cases should be given; (3) five-year results of early (confined to cervix) cases; (4) operability rate, and (5) primary mortality of the treatment used.

The technique used at the Woman's Hospital is described rather carefully. They have 280 milligrams of radium salt and use an average initial dose of 2400–4200 mg-hr. They believe that one can get as good results with reapplication of smaller doses as with massive irradiation. They consider blood transfusion a valuable aid during the toxic stage accompanying the sloughing after radium treatment. They do not use roentgen therapy as a routine adjunct to radium.

A number of unusual cases are briefly summarized; they include among others the recovery of several apparently hopeless cases, negative microscopical study of uteri removed at varying intervals after radium therapy for cervical carcinoma, and the use of radium in carcinoma of the fundus in patients who were poor operative risks.

The Woman's Hospital statistics do not seem to indicate that the type of carcinoma cell as reported from the pathological laboratory is at present a reliable guide in prognosis.

In 300 consecutive cases of carcinoma of the cervix, 96 per cent were found to have had a pregnancy. Ward advocates early and careful repair of cervical lacerations as prophylaxis against carcinoma of the cervix. He warns against the danger in the indiscriminate use of radium by inexperienced physicians, especially in view of the commercial exploitation of radium.

His conclusions are that radium is preferable to surgery in all cases of cervical carcinoma and that all borderline cases fall within the range of radium rather than operation. He believes that radical surgery in the early cases will give as good results as radium but with a higher primary mortality and a greater morbidity rate.—*R. S. Bromer.*

Weigand, Hans. Is the gradation of the roentgen doses possible and desirable in the production of permanent amenorrhea? *Strahlentherapie*, 1928, xxx, 497–502.

The author advocates the use of the Kadisch table, which is a "dose table" for the production of a permanent and temporary amenorrhea, the dose being graduated according to the age of the patient and to the size of the lesion. The technique of exposure is indicated as follows: 195 kv., 4 ma., 0.5 mm. Zn plus 4 mm. Al, 50 cm. skin target distance, dose in r (1 e = 5.54 r). The gradation according to age is made between twenty and sixty for a period of every five years. The gradation according to the lesion is made for metropathies, small myomas, medium myomas and large myomas. By applying the values of this table in 600 cases, 450 of which were followed

up, the author found that in 99.6 per cent desirable results were produced.

The advantages of such a procedure are that the roentgen reaction is minimized, that the climateric changes produced are of very slight degree and that considerable time and money are saved.—*T. Leucutia.*

WERNER, R. Irradiation results, with case reports, in tumors. *Strablentberapie*, 1928, xxxi, 16–32.

Twenty cases of very far advanced malignant tumors are described where radiation therapy has produced unexpected cures. The cases cited are: (1) a carcinoma of the maxilla, healed for three and a half years; (2) a carcinoma of the tongue with infiltration of the deep structures and extensive lymph node metastasis, healed for eight and a half years; (3) a carcinoma of the floor of the mouth with involvement of the submaxillary lymph nodes, healed for six years; (4) a recurrent melanosarcoma with extensive metastases, healed for five and a half years; (5) a bronchiogenic carcinoma with metastasis to adjacent lymph nodes, healed for ten years; (6) a struma magna with compression and severe respiratory disturbances, healed for four years; (7) a periosteal sarcoma of the sternum, healed for eight and a half years; (8) a spindle cell sarcoma of the upper arm, healed for eight years; (9) a sarcoma of the upper arm in a hemophiliac, healed for seventeen years; (10) a recurrent mammary carcinoma with extensive skin metastases, healed for six years; (11) a recurrent mammary carcinoma with metastases to the lumbar spine, healed for six years; (12) a large mediastinal tumor with pressure symptoms, healed for eight years; (13) a large mediastinal tumor with secondary stasis, healed for fourteen years; (14) a recurrent carcinoma of the prostate with metastases to the cervical spine, healed for three years; (15) a recurrent sarcoma of the inguinal lymph nodes with extensive metastases, healed for nine and a half years; (16) a lymphosarcoma of the inguinal lymph nodes with metastases to the cervical lymph nodes and again recurring ten and eleven years later, healed; (17) a metastatic seminoma, healed for four years; (18) a recurrent carcinoma of the ovary, healed for three years; (19) a carcinoma of the sigmoid incompletely removed, healed for eleven years, and (20) an inoperable carcinoma of the papilla Vateri still healed at the time of accidental death three years later.

From this the author arrives at the conclusion that all malignant conditions should be treated systematically. It is impossible to foretell which of the cases will respond to irradiation. Therefore even those entirely hopeless should receive a curative dose. Of course the general condition of the patient has to be taken into consideration and the dose administered accordingly. The administration of only a palliative dose in the above enumerated cases would have meant an incomplete procedure, most probably leading to death of the patient.—*T. Leucutia.*

MISCELLANEOUS

ALBEE, FRED H. The autogenous bone graft in spondylolisthesis. *Radiology*, 1928, xi, 340–343.

Spondylolisthesis is a displacement of the whole spinal column forward in relation either to the fifth lumbar vertebra and sacrum and pelvis, or the sacrum and pelvis. There is forward subluxation of the body of the fourth or fifth lumbar vertebra on the vertebra below it, or upon the sacrum. The fifth lumbar vertebra is most commonly displaced, the fourth less often, and the sacrum rarely. In a very large percentage of cases there is a contributing cause of congenital failure in vertebral development.

Inasmuch as the symptoms are due to the vertebral displacement, resulting in overstretching and undue tension upon the ligaments surrounding the vertebrae (increased by standing and lifting), the rationale of treatment is almost entirely mechanical.

The mechanical features of the autogenous bone graft operation are exceptionally well adapted to this most difficult problem. A strong autogenous graft inlaid into the spinous processes of the lower lumbar vertebrae and carefully coapted onto the posterior surface of the sacrum affords very firm immobilization. The results have been most satisfactory in the 11 cases in which the author has employed this operation.—*J. D. Camp.*

BARTH, WALTHER. Roentgen stereoscopy in relation to optic physiology. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 299–311.

The author discusses the optic basis of photographic and roentgenographic stereoscopy.

(1) Monocular spatial vision of photographic films. In viewing a photographic film monocularly there are certain criteria which give the impression of a spatial vision. These are: (*a*) the influence of the geometric perspective, objects of similar size appearing proportionally smaller as the distance from the observer increases; (*b*) overlapping and covering of two objects, the object which overlaps or covers appearing the nearer; (*c*) the shadow effect produced by the one-sided lighting of the

object, and (*d*) the influence of the air perspective, objects appearing the hazier the greater the distance from the observer.

(2) Perspective in roentgenograms. (*a*) The influence of the geometric perspective is of no value in a roentgenogram. In photographs the geometric perspective is evident when the distance is 10 meters or more, while in roentgenograms the distance is much smaller. (*b*) The overlapping and covering of different objects is of no aid in roentgenography since the image is that of transparencies and not of surfaces. (*c*) There is no shadow effect in the roentgenogram. (*d*) The air perspective is also non-existent. On the contrary, in roentgenography the objects nearest to the film and thus the farthest from the observer appear the sharpest.

(3) The difference in the representation of a photograph and roentgenogram and its influence on the stereoscopic viewing. In the photograph the points of different depth fuse into lines and surfaces, while in the roentgenogram, because of the transparency, the image represents points without any accurate delimitation of the objects. This is very important in view of the fact that the summation of the points into surfaces forms a good optic subject, while points scattered in space cannot give the true impression of a spatial vision.

(4) The viewing of roentgenograms. The only way to express the spatial effect in a roentgenogram is by representation of the depth dimensions and by an accurate knowledge of the objects represented. For this purpose a base of 6 to 12 cm. is recommended in the taking of roentgenograms with a focus film distance not less than 1 meter. The incidence of the ray should correspond to the incidence of monocular vision of the object.—*T. Leucutia.*

Bernstein, Arnold, and Klose, Wilhelm. Protection against stray radiation in roentgenoscopy. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 107–120.

The covering of the roentgen-ray tube with protective material does not guard the roentgenologist sufficiently against stray radiation. This is especially true for the roentgenoscopic examination. The authors in taking actual photographs of the roentgen-ray beam produced by different roentgen tubes found that the useful radiation emanating from the focal spot of the target is not all the radiation that a roentgen tube emits. In addition to this there is a stray radiation which has its origin in the marginal spots of the anticathode as well as in the different metallic parts of the tube. If the working aperture of the protective tube box is too close to the roentgen tube the stray rays may pass through the aperture and since their direction is manifold they may pass along the margins of the roentgenoscopic screen and thus expose the operator. This harmful radiation sometimes represents as much as 10 per cent of the total radiation.

In order to eliminate the dangers of this stray radiation it is advised that the working aperture be far away from the tube, or still better, that two diaphragms be used, one on the tube box and another nearer the roentgenoscopic screen, and that the space between the two diaphragms be inclosed with a suitably protected tube or cone. It is recommended that these protective measures be applied in every instance.—*T. Leucutia.*

Bouwers, A. A new *x*-ray apparatus with complete *x*-ray and electrical protection. *Acta radiol.*, 1928, ix, 600–605.

A very simple roentgen-ray unit is described which can be easily transported in two small cases. The simplicity of the apparatus is obtained by the fact that the roentgen tube, which is a Metalix tube, is provided with a central metal part which can be connected to earth. The secondary windings of the high tension transformer as well as the cables (covered with flexible metal tubing) are likewise connected to earth. There is absolutely no danger in touching any part of the apparatus during operation. A safety device is provided which prevents the tension being switched on before all parts of the apparatus are grounded.

The focal spot of the roentgen tube is very small; because of the lack of danger from actual contact the tube can be brought very close to the patient so that roentgenograms can be taken at very short distances. This again reduces the amount of energy required for the taking of the roentgenogram.

The output of the apparatus is 60 kv. (max.) and 7 ma. A good skull roentgenogram can be taken in about five seconds. Since the anticathode is provided with a cooling device several roentgenograms can be taken in succession. The apparatus may also be used for roentgenoscopic purposes.—*T. Leucutia.*

Bouwers, A., and Diepenhorst, P. The intensity of roentgen rays as a function of the angle of their departure from the anticathode surface. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 894–898.

The authors measured by means of a photographic method specially devised the intensity of roentgen rays for different angles of departure from the anticathode surface. The results obtained were tabulated and then plotted

graphically. The type of radiation was that of 70 kv. unfiltered, and with 10 mm. Al filter. It was found that when using the 10 mm. Al filter which generally corresponds to the thickness of the patient, a decrease of only 20 per cent of the intensity of the roentgen rays occurs for the rays which leave the surface of the anticathode under an angulation of 2°. From 20° angulation on, the decrease in the intensity of radiation is nil.—*T. Leucutia.*

BRAUN, R., HASE, H., and KÜSTNER, H. On the doses applied in roentgen diagnosis as expressed in R units. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 385–398.

The authors determined the amount of radiation expressed in R units which can be used in roentgenoscopy or roentgenography without any deleterious effects to the patient. An instrument independent of wave length was used for measuring purposes. The factors were as follows: Intensiv-Reform apparatus, Coolidge hot cathode tube, 30 kv. peak, no filter; or 100 kv. peak with 6 mm. Al filter, 1 meter skin target distance and 1 ma. The quality of the roentgen-ray beam was determined by the half-value layer in millimeter aluminum and the per cent of decrease of the intensity was calculated through 1 mm. cellon. The figures of both the dose and quality were arranged in an R table.

For the calculation of the above figures for various skin target distances and milliampere values a second D table is furnished for roentgenoscopy and a third A table for the roentgenographic exposures. The multiplication of the figures in table R with the factors in table D gives the number of R per minute in roentgenoscopy, and the multiplication of the factors in table A with the figures in table R gives the number of R per second for roentgenography. From the per cent of decrease in the intensity of the original radiation through 1 mm. cellon we are able to calculate the decrease of the radiation for any given air distance since 109 cm. air is equal to 1 mm. cellon.

For the doses applied in skin therapy a small thimble ionization chamber independent of the wave length is used. The amount of scattering for different size fields on the surface of a water phantom is determined (for 30 kv. peak without filter and 200 kv. peak with 4 mm. Al). The dose considered as still harmless is given in the literature as 200 R but since some apparatus deliver 100 per cent more scattered radiation the author considers a safe dose which can be given without cosmetic injuries to the skin as 100 R. With the aid of tables R, D and A the practitioner can easily determine the value of the radiation of his apparatus and its approach to to the cosmetic danger point.

The author finally examines the high R values obtained in the roentgen examination of certain organs such as spine, pregnancies, stomach, etc., and emphasizes the necessity of the application of a thick aluminum filter in such instances.—*T. Lecuutia.*

CHANTRAINE, HEINRICH. On exposures with soft rays with the constant tension machine "Trifas" made by the "Sanitas" Electrical Company. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 534–541.

In experimenting on exposures with soft roentgen rays by using low voltage and high milliamperage in order to obtain better contrast, the author found that a constant tension machine is most suited for the purpose. A rectified high tension current does not represent as yet a current of a constant tension for a variation as high as 13 per cent is often encountered. Since in exposures with soft rays a variation of only 5 per cent produces a marked decrease in the blackening of the film, a machine of constant tension has to be used. About a year and a half ago the Sanitas constructed two types of such machines (Trifas), one with an output of 37 kv. and up to 2000 ma., and the smaller with 37 kv. and only 150 ma. By the use of these constant tension machines a considerable reduction of the time of exposure is obtained. Thus a pulmonary roentgenogram of a female can be obtained with 37 kv., 280 ma., 1.30 meter distance in 0.2 to 0.25 second, while for a man the factors are 37.7 kv., 250 ma., 1.30 meter distance and 0.3 to 0.35 second exposure. Very recently the author constructed a roentgen tube with a rotating anticathode which permits a still further load of the tube with two rotations per second and with a rotating circle of 2.5 cm. diameter. The load can be increased considerably above that of the usual fine focus tube with a fixed anticathode. It is hoped that by an increase of the number of rotations per second and of the diameter of the rotating circle a load of 2000 ma. can be passed through a fine focus tube.—*T. Leucutia.*

CHANTRAINE, HEINRICH, and PROFITLICH, PAUL. The protection of the physician and his assistants against roentgen rays. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 121–128.

Glocker and Kaupp were the first to investigate the quantity of a scattered radiation by means of a fluoroscopic screen. They found that a radiation which barely produces a fluores-

cence of an astral screen corresponds to a dose which will produce a skin erythema within 24,000 hours. This method of determination, however, is not very accurate. The scattered radiation produced in a room is in every direction and therefore a fluoroscopic screen shows only those rays which hit the screen from the back, while the rays hitting the screen from the side and from the front are entirely neglected. Thus the above value is too small for the total amount of the scattered radiation. For this reason the authors undertook to determine the scattered radiation by means of an ionization chamber and to compare the value so found with that measured by the fluorescence of a screen.

First they re-determined the amount of radiation necessary to produce a bare fluorescence of the astral screen by the direct method, that is, they placed an x-ray machine on a pitch dark night in a garden and determined the distance at which the astral screen still showed fluorescence. They found that this was at a point of 54 meters; then the above value for the air was calculated for water and it was found that the absorption of 54 meters of air would correspond to 6 cm. of water. From this the decrease in the intensity of the roentgen beam was figured and it was determined that the dose which would produce a barely visible fluorescence of an astral screen would be an erythema dose in 68,000 hours. But, by taking into consideration the radiation from other directions the sensitivity of the astral screen was evaluated as between 32,000 and 68,000 S.U.D. hours.

Then the measurements were carried out by the ionization chamber. This was constructed of graphite and was 18 cm. in diameter and 18 cm. in height, of a cylindric form and provided with a Braun electrometer for 10,000 volts. The chamber was independent of wave length and when standardized with the Küstner instrument it was found that 0.0062 R produced a drop in the electrometer of 8000 to 7000 volts.

The following amount of scattered radiation was found in different working conditions: (*a*) in deep therapy behind a Kampe-Lorrey screen of 2 mm. height 1/30,000 S.U.D. hours; (*b*) in the roentgenoscopic examination of a stomach 1/12,000 S.U.D. hours (72 to 81 kv. maximum, 5 ma., 1.50 meter distance); (*c*) in roentgenography behind a lead screen less than 1/20,000 S.U.D. hours; (*d*) in the autoprotective Phoenix roentgen tube $\frac{1}{2500}$ to $\frac{1}{3500}$ S.U.D. hours (82 to 71 kv. maximum, 5 ma., 1.50 meter distance); (*e*) in the new metalix and the autoprotective Müller tubes less than $\frac{1}{2000}$ S.U.D. hours (by using the same factors as for the Phoenix tube).—*T. Leucutia.*

Cole, Lewis Gregory. The living stomach and its motor phenomenon. *Acta radiol.*, 1928, ix, 533–545.

The living stomach is composed of two columns, a large vertical column including the fornix or the dome of the stomach, and the corpus, and a smaller vertical or oblique column including the pylorus and the cap. The adjacent sides of the two columns form a recedent angle, the apex of which is the incisura angularis. On the right side of the corporic column there is an area called the intraperitoneal gastric triangle which is very important from the point of view of formation of ulcers so that it is often called the ulcer triangle.

The motor phenomenon of the living stomach is characterized by:

(1) Peristalsis. The term "gastric peristalsis" is applied to those constricting rings in the stomach which progress toward the pylorus, in contradistinction to any other movement of the stomach. It is primarily the function of the muscularis mucosae and not of the regular muscular coats. The four-cycle gastric peristalsis is considered normal. The progressive peristaltic ring nearest the pylorus has been called the terminal contraction. The pyloric canal is encircled by a thick, dense, harp- or fan-shaped muscle which has a special function and special nerve supply. The term "pyloric sphincter" is incorrect. The thickening of the gastric wall which the surgeon and the pathologist feel at the pylorus is not the pyloric sphincter but is the pyloric canal. The term "pyloric valve" or "fold" is applied by roentgenologists to a muco-membranous fold which does not contain the regular muscular coats. It is simply a fold that contains the mucosa, muscularis mucosae and a core of submucosa.

(2) Maceration. The function of the pyloric canal is maceration or the squeezing of the fluid contents from the solid. The pyloric canal contracts in a concentric rather than a progressive manner, the normal contraction causing a shortening of the space between the valve and the sulcus angularis. Immediately following the contraction there is a relaxation of the muscles and as this relaxation occurs the cap reassumes its former dimensions and position. The contraction and relaxation of the stomach as a whole are called systole and diastole.

(3) Filtration. Filtration is a function of the valve. During the stage of gastric systole the pyloric valve is opened and a small amount of

fluid (chyme) is squirted through the lumen. During the stage of diastole the valve is closed.

(4) Evacuation. Gastric evacuation is controlled by a broad peristaltic contraction of the small intestine.

(5) Sthenia. This refers to the size, shape and position of the stomach relative to the body habitus.

(6) Tone. The tone is the result of the action of the intrinsic gastric muscles.

(7) Cycle. Cycle is the series of shapes which the stomach assumes approximately every twenty seconds and which is composed of a general systole and diastole.—*T. Leucutia.*

DEHLER, HANS. Streptococci in uterine carcinoma; their virulence, and their affection by deep roentgen therapy. *Arch. f. Gynäk.*, 1928, cxxxiv, 228–249.

The most important and most dangerous bacteria found in infected uterine carcinomas are the streptococci. These in penetrating through the ulcerated surface into the deeper structures may produce inflammations of the most severe character. It is well known that the normal vaginal secretion contains various forms of streptococci which under certain circumstances may lead to postoperative or puerperal infections. The factor regulating the aggressiveness of these microbes is their virulence. Every infection is a battle between the microbe and macroorganism and is characterized by the virulence of the microorganism on the one side, and by the resistance mechanism of the macroorganism, on the other.

The author determined the virulence of the streptococci found on the surface of uterine carcinomas by means of the Ruge-Philipp test. The technique was the one originally used by Philipp and the procedure was as follows: 2 to 6 platinum loops of normal secretion were inoculated into the usual bouillon test tubes. Two to 4 platinum loops were then taken from this bouillon mixture and inoculated into 6 to 8 c.c. blood taken from the arm vein and defibrinated by shaking in an Erlenmeyer flask; 1.5 c.c. of this blood-secretion mixture and 10 c.c. agar were placed in a Petri dish and incubated at 37°c. The rest of the blood-secretion mixture was then placed at 37°c., and the procedure was repeated three, six, nine and twenty-four hours later. The following day the number of colonies was counted and according to whether the colonies in the second or third Petri dish were increasing or decreasing in number the streptococci were declared of a virulent or an avirulent character.

The Ruge-Philipp test was carried out 246 times in 89 cases of uterine carcinoma, 38 cases of which had received no preliminary treatment, thus representing an uninfluenced flora. Streptococci were found, in 91 per cent of the 38 untreated cases; in 66 per cent hemolytic streptococci, 39 per cent being of a virulent and 27 per cent of an avirulent form. As a result of further investigations one may say that the more extensive and the more necrotic the tumor, the more pronounced the infection and the higher the number of the virulent hemolytic streptococci.

The uterine carcinomas were then treated by deep roentgen therapy by applying a dose of 110 per cent S.U.D. through five to six concentric portals of entry. Six to eight days later and again seven to eight weeks later, the Ruge-Philipp test was repeated and it was found that in only 12 per cent was there evidence of hemolytic streptococci. This number was reduced at the end of three months to 8 per cent.

In another series radium therapy was used and again the Ruge-Philipp test was done two to six days and several weeks later. Here the decrease in the virulence of the streptococci was still more pronounced.

The author then draws a parallelism between the phenomena observed after irradiation in his cases and the phenomena of Heidenhain and Fried following the treatment of acute and subacute infections, and arrives at the conclusion that the action of the irradiation in the two instances must be identical except for the fact that in infected uterine carcinomas the infection does not clear up until five to seven weeks after roentgen irradiation, while in acute and subacute infections this follows much sooner.—*T. Leucutia.*